

# Ukraine
# and innovations for tomorrow

## Mapping of Research and Innovation Needs in Ukraine to Increase Living Standards and the Creation of New Opportunities for Self-realization of Citizens

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**Preface**..... 3

## Key Findings..... 4

**Part I. Setting the Scene: Ukraine as a Living Laboratory for Innovation**..... 5
1. Introduction
2. Ukraine as a Strategic Environment for Innovation
3. The Shift from Energy Infrastructure to Energy Services
4. Digital Transformation and Institutional Adaptation
5. Human-Centred Innovation and the Future of Reconstruction
6. Implications for research and innovation collaboration

**Part II. A New Innovation Paradigm**.....11
7. The Iceberg Model as an Innovation Framework
8. Human-Needs-Driven Innovation Systems
9. Strategic Implications for Sweden

**Part III. Ukraine's Innovation Ecosystem**.....17
10. The Emerging Architecture of Ukraine's Innovation Ecosystem
11. National Leadership and Strategic Direction
12. WINWIN and the Strategic Direction of Ukrainian Innovation
13. Municipalities as Platforms for Transformation
14. Ukraine's International Collaboration Landscape
15. Sweden's Strategic Position

**Part IV. Energy, Resilience and Reconstruction**.....23
16. Strategic Opportunities
17. Strategic Implications
18. From Energy Security to Energy Resilience
19. Why Ukraine Matters for Future Energy Research
20. Healthcare as an Energy Resilience Priority
21. Water Infrastructure and Essential Services
22. District Heating and Thermal Resilience
23. Municipal Energy Management and Digital Energy Systems
24. Energy-Positive Reconstruction and Living Laboratories

**Part V. Future Collaboration Between Sweden and Ukraine**.....32
25. Future Research Calls
26. Strategic opportunities

**Detailed Findings and Analysis**…… 34
Introduction
0. Methodology and participants

**A: Ukraine's innovation ecosystem: Focus and priorities**…… 48
1. Ukraine's Innovation ecosystem
2. Ukraine's Innovation capacity and needs (including a SWOT analysis)

**B: Collaboration: Innovation and impact**…… 98
3. Ongoing research and innovation collaborations: Ukraine-EU
4. Ongoing research and innovation collaborations: Ukraine-Sweden

**C. Energy research and innovation needs in Ukraine**…… 113
5. Energy research & innovation, priorities and needs
6. Resilient energy systems in Ukraine
7. Pathways for resilient energy systems in Ukraine

**D: Opportunities and ways forward**…… 138
8. Global leadership through Ukraine-Sweden collaboration
9. Possible structure for research- and innovation collaboration between Ukraine-Sweden
10. Potential synergy and acceleration frameworks for Ukraine–Sweden Research and Innovation Cooperation
11. Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems

**Reference Appendices**…… 173
R1. Reference studies

**Reference Appendices (separate document)**
R2. Assessment of SMEs from Techstep
R3. EnergyStep Sweden–Ukraine 2027–2028
R4. Mapping of companies in the WINWIN GreenTech document
R5. Combined actor mapping
R6. Distributed energy and resilience project clusters
R7. Possible structure for research- and innovation collaboration between Ukraine-Sweden – detail for Chapter 9
R8. Synergy and Acceleration Frameworks for Ukraine–Sweden Research and Innovation Cooperation – detail for Chapter 10

# Preface

The purpose of this study is to provide the Swedish Energy Agency, Vinnova, Formas, the Swedish Research Council, and the Swedish Civil Defence and Resilience Agency with a consolidated strategic and thematic evidence base to inform future research and innovation initiatives in cooperation with Ukraine.

The study:

- Identifies research and innovation needs, opportunities and barriers in Ukraine where Swedish initiatives could help scale up cooperation with Ukrainian academia, research institutes, testbeds and public authorities.
- Maps areas in which Sweden and Ukraine can create mutual benefit, particularly in energy, resilience, digitalisation and security.
- Proposes concrete initiatives, test and demonstration environments, and potential programme designs.
- Places Swedish initiatives within their wider EU and international context.

The report assesses Ukraine's current needs, opportunities and barriers across its research and innovation system, covering academia, research institutes, testbeds, companies, innovation environments, public authorities and regional actors.

It focuses on opportunities for mutually beneficial Swedish–Ukrainian cooperation in energy, societal resilience, digitalisation, security, sustainable reconstruction, mobility, industrial transformation and emerging technologies. The analysis considers Ukraine's reform and EU accession agenda and the wider international context. It informs concrete proposals for programmes, test and demonstration environments, policy initiatives, innovation calls and collaboration models that can support Ukraine's reconstruction while strengthening Swedish competitiveness, preparedness and long-term innovation capacity.

The report is written in English to make it accessible to both Swedish and interested Ukrainian partners, as well as relevant EU and international partners involved in research, innovation and reconstruction cooperation.

Generative AI tools were used to support literature review and text summarisation by helping identify themes, compare sources, organise evidence and draft concise summaries. All final texts were reviewed by the authors, and responsibility for interpretation, accuracy and final wording remains with the report authors.

Numbered footnotes within the report link to relevant reference materials used in the analysis. Each chapter's footnotes contain the references used in that chapter.

The report provides independent analysis based on direct input from experts and background material available publicly at the time of writing, it is not an academic peer-reviewed publication.

The authors extend special thanks to the Ukrainian participants who, amid the daily realities of Russia's full-scale invasion, contributed with remarkable passion and dedication while addressing both urgent needs and continuing to shape Ukraine's long-term future.

# Key Findings

# Part I. Setting the Scene: Ukraine as a Living Laboratory for Innovation

## 1. Introduction

Ukraine is frequently described through the lens of war, reconstruction, and humanitarian recovery. While these dimensions remain fundamental, they provide only a partial understanding of the country's emerging significance. The analysis presented in *Ukraine and Innovations for Tomorrow* suggests that Ukraine should increasingly be understood as a strategic innovation environment whose relevance extends far beyond post-war reconstruction. The country is simultaneously rebuilding critical infrastructure, reforming governance systems, advancing digital transformation, accelerating integration with European institutions, and experimenting with new forms of mission-oriented innovation under conditions of exceptional uncertainty.

This combination of circumstances is historically unusual. Most innovation systems evolve under relatively stable institutional conditions. Ukraine's innovation ecosystem is developing under conditions of continuous disruption, where the functionality of healthcare systems, energy infrastructure, municipal services, communications networks, and public administration cannot be taken for granted. Under such conditions, innovation is evaluated less according to novelty or commercial potential and more according to its capacity to maintain essential societal functions. As a consequence, Ukraine is generating practical experience concerning resilience, adaptation, digital governance, and systems transformation that is increasingly relevant far beyond its national borders.

The report argues that Ukraine should not be viewed primarily as a recipient of reconstruction assistance but as a partner in the development of future energy systems, future innovation systems, and future models of societal resilience. Many of the challenges currently being confronted in Ukraine, including energy security, infrastructure resilience, digital dependency, cyber threats, demographic change, and climate adaptation, are likely to become increasingly significant across Europe during the coming decades. Ukraine therefore represents an opportunity not only to contribute to reconstruction but also to learn from one of the most intensive real-world experiments in resilience and societal adaptation currently underway.

A central argument of the report is that reconstruction should be understood not as restoration but as transformation. Rather than rebuilding the systems that existed before the war, Ukraine has an opportunity to develop new forms of infrastructure, governance, and innovation ecosystems that are better aligned with future societal needs. This perspective is particularly relevant in the energy sector, where reconstruction can accelerate the transition toward decentralised, digitally integrated, and resilience-oriented energy systems while simultaneously contributing to broader objectives such as healthcare continuity, housing quality, economic participation, and human wellbeing. This transformation perspective is reinforced by *An Environmental Compact for Ukraine*, which argues that decisions taken during the war already shape the prospects for a clean, green and resilient recovery.

## 2. Ukraine as a Strategic Environment for Innovation

The report situates Ukraine within a broader transformation of innovation policy. Historically, innovation strategies have often been assessed through indicators such as economic growth, productivity, export performance, patent generation, startup creation, and research expenditures. While these measures remain important, they provide only indirect evidence concerning whether innovation contributes to improved living conditions, societal resilience, or opportunities for human development.

Ukraine increasingly operates in an environment where such indirect indicators are insufficient. The ability of hospitals to continue functioning during power outages, the capacity of municipalities to maintain water services under conditions of infrastructure disruption, and the resilience of digital government platforms have become immediate concerns. Innovation is therefore evaluated according to its contribution to concrete societal outcomes rather than solely according to economic outputs.

This distinction is important because it highlights a broader transition occurring within innovation policy internationally. The report argues that future innovation systems will increasingly be expected to demonstrate their contribution to societal goals including resilience, wellbeing, health, sustainability, and opportunities for self-realisation. Ukraine provides a particularly valuable environment for exploring such approaches because many of these questions have become operational realities rather than theoretical discussions.

**Table 1. Contrasting Innovation Contexts**

| Dimension | Conventional Innovation Systems | Ukraine's Current Innovation Context |
|---|---|---|
| **Primary objective** | Competitiveness and growth | Resilience and continuity of societal functions |
| **Innovation cycle** | Multi-year planning & deployment | Rapid experimentation & deployment |
| **Key evaluation criteria** | Economic performance and innovation outputs | Societal outcomes and operational effectiveness |
| **Dominant risks** | Market and technology risks | Systemic societal risks |
| **Relationship innovation ↔ public services** | Often indirect | Direct and immediate |
| **Stakeholder incentives** | Commercial and institutional | Mission-oriented and societal |

The significance of this distinction extends beyond Ukraine itself. Many advanced economies increasingly face challenges associated with climate-related disruptions, cyber threats, ageing populations, infrastructure vulnerabilities, and growing dependence on digital systems. The Ukrainian experience therefore offers insights into the kinds of innovation capabilities that may become increasingly important elsewhere.

Suggested reading:

1. **Chapter 1:** Connects Ukraine's dynamic innovation ecosystem to daily life systems, tangible wellbeing outcomes and long-term sustainability.
2. **Chapter 6:** Defines Ukraine as a real-world laboratory where distributed energy resources are assessed by continuity of essential services under severe disruption.
3. **Chapter 11:** Contrasts proxy indicators of innovation activity with direct measures of essential human needs, resilience and societal outcomes.

## 3. The Shift from Energy Infrastructure to Energy Services

One of the report's most important contributions concerns the conceptual framing of energy systems. Traditional energy policy frequently focuses on generation capacity, transmission networks, fuel security, storage technologies, and market design. These remain important concerns, but the report argues that they should increasingly be understood as components of a broader societal system.

The fundamental purpose of energy systems is not the production of electricity or heat as such. Rather, energy systems enable healthcare, education, communications, mobility, housing, economic activity, and social participation. The disruption of energy services therefore has consequences that extend far beyond the energy sector itself.
Ukraine's experience makes this relationship unusually visible. Repeated attacks on energy infrastructure have demonstrated how energy disruptions affect hospitals, water systems, schools, digital services, and municipal governance. As a result, energy resilience has increasingly been understood not merely as an infrastructure challenge but as a societal capability.

This perspective has significant implications for research and innovation. Rather than asking how to optimise individual components of the energy system, the report encourages consideration of how energy systems contribute to the continuity of essential services and the maintenance of societal functions.

**Table 2. From Infrastructure Thinking to Service Thinking**

| Traditional Perspective | Emerging Resilience Perspective |
|---|---|
| **Energy as a sector** | Energy as an enabling system |
| **Focus on generation and networks** | Focus on societal outcomes |
| **Infrastructure performance** | Service continuity |
| **Technical resilience** | Societal resilience |
| **Asset optimisation** | Capability preservation |
| **Energy security** | Human-centred security |

This shift provides an important foundation for understanding the report's recommendations regarding resilient energy systems, municipal innovation, healthcare infrastructure, and reconstruction strategies.

Suggested reading:

1. **Chapter 6 - Resilient energy systems in Ukraine:** Defines service resilience by whether energy configurations maintain healthcare, water, heating, housing and transport functions during disruption.
2. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Positions energy as a foundational system for human wellbeing and proposes research on energy services for resilient daily life.
3. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Maps implemented decentralised energy systems that sustain healthcare, water, heating and housing functions rather than merely adding generation capacity.

## 4. Digital Transformation and Institutional Adaptation

The report identifies digital transformation as one of Ukraine's most significant achievements. Through initiatives such as Diia and related programmes, Ukraine has developed one of the world's most advanced digital governance ecosystems under exceptionally challenging conditions.

The importance of this achievement extends beyond administrative efficiency. Digital governance has become an essential component of societal resilience. The ability to maintain access to public services, official documentation, business registration, social support mechanisms, and government communications contributes directly to societal stability and adaptive capacity.

The report highlights the Ministry of Digital Transformation as an example of institutional innovation. Its success demonstrates how clear missions, strong leadership, digital infrastructure, and close interaction between public institutions and innovation ecosystems can accelerate implementation even under adverse circumstances.

For energy systems, this observation is particularly important because future energy infrastructure will increasingly depend on digital platforms, data systems, artificial intelligence, predictive analytics, cybersecurity, and distributed control architectures. Ukraine therefore provides valuable experience concerning the integration of digital and physical infrastructure under conditions of systemic stress.

Suggested reading:

1. **Chapter 2 - Ukraine's Innovation capacity and needs:** Maps the Ministry of Digital Transformation, Diia and the digital backbone supporting public services, cyber resilience and modern energy systems.
2. **Chapter 5 - Energy research & innovation, priorities and needs:** Specifies digital twins, AI-enabled forecasting, secure data exchange and cybersecurity priorities for distributed energy infrastructure.
3. **Chapter 11 - Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems:** Explains how Diia's integrated digital government infrastructure supports continuity of public services, participation, resilience and entrepreneurship.

## 5. Human-Centred Innovation and the Future of Reconstruction

A recurring theme throughout the report is the importance of moving beyond sector-specific approaches toward human-centred innovation. This perspective is particularly visible in discussions concerning the WINWIN 2030 strategy, which explicitly emphasises the creation of opportunities for self-realisation as a central societal objective.

The report argues that innovation should increasingly be evaluated according to its contribution to human development. While economic growth remains important, growth alone provides an incomplete measure of progress. Questions concerning wellbeing, participation, resilience, capability development, and quality of life become increasingly important when assessing long-term societal outcomes. The Compact's planetary-boundaries framing complements this human-centred approach by defining the objective as better lives within ecological limits.

The Superhumans initiative provides one of the clearest illustrations of this perspective. Although often described as a rehabilitation centre, the report interprets Superhumans as a broader innovation ecosystem that combines healthcare, technology, architecture, education, employment, and social reintegration around the objective of restoring human capabilities.

This example is significant because it demonstrates how reconstruction can become a platform for institutional innovation. Rather than restoring previous arrangements, reconstruction can create new systems designed explicitly around human needs and long-term societal goals.

Suggested reading:

1. **Chapter 2 - Ukraine's Innovation capacity and needs:** Presents Superhumans as an innovation ecosystem centred on restored human capability, integrating healthcare, rehabilitation, employment and social reintegration.
2. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Develops Superhumans into a reconstruction mission organising technology, energy, healthcare, housing and public services around human capabilities and daily life.
3. **Chapter 11 - Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems:** Links WINWIN's self-realisation objective to Superhumans as a multidimensional ecosystem for capability, participation, employment and wellbeing.

## 6. Implications for research and innovation collaboration

The report's findings suggest that Sweden occupies a particularly favourable position for collaboration with Ukraine. Sweden possesses internationally recognised strengths in district heating, sustainable urban development, digitalisation, industrial transformation, energy-system integration, and public-sector innovation. Ukraine contributes complementary strengths in resilience, rapid deployment, adaptive governance, engineering talent, and mission-oriented innovation.

These complementarities create opportunities that extend beyond conventional research collaboration. The report suggests that future initiatives should focus on integrated systems rather than isolated technologies. Particular attention is directed toward resilient energy systems, healthcare infrastructure, municipal innovation, district heating transformation, digital energy management, and human-centred reconstruction.

From the perspective of collaboration in the area of energy, the most important implication may be that Ukraine offers opportunities not only to deploy existing Swedish expertise but also to generate new knowledge. The country's reconstruction process provides a unique environment for understanding how energy systems can contribute to resilience, wellbeing, and societal capability under conditions that are likely to become increasingly relevant across Europe.

In this sense, collaboration with Ukraine should be viewed not only as support for reconstruction but also as an investment in the future development of energy systems and innovation systems more broadly.

Suggested reading:

1. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Structures a shared mission around resilient energy systems, aligned research themes, demonstration projects and a Sweden–Ukraine innovation cluster.
2. **Chapter 4 - Ongoing research & innovation collaborations: Ukraine- Sweden:** Maps the existing Sweden–Ukraine collaboration portfolio and identifies opportunities to coordinate complementary strengths across energy, digitalisation, governance and resilience.
3. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Combines Ukrainian resilience experience with Swedish systems expertise through bilateral research calls, innovation clusters and dual testbeds.

# Part II. A New Innovation Paradigm

## 7. The Iceberg Model as an Innovation Framework

The Iceberg Model is frequently used in systems thinking to distinguish between visible outcomes and the deeper structures that generate them. Events represent only the most visible layer. Beneath them lie recurring patterns, institutional arrangements, underlying assumptions, and ultimately the purpose that guides system behaviour.

The report applies this framework to Ukraine's innovation ecosystem and reaches an important conclusion. Much international attention focuses on visible events such as reconstruction projects, digital-government initiatives, startup activity, energy-system modernisation, or wartime technological innovations. While these developments are important, they are symptoms of deeper transformations occurring within Ukraine's institutional landscape.

**Table 3. Iceberg Model Applied to Ukraine's Innovation Ecosystem**

| Iceberg Layer | Ukrainian Context | Strategic Significance |
|---|---|---|
| **Events** | Reconstruction projects, Diia, Brave1, WINWIN, energy resilience programmes | Visible manifestations of innovation |
| **Patterns** | Rapid deployment, mission-driven collaboration, resilience-oriented innovation | Emerging innovation culture |
| **Structures** | Ministries, municipalities, innovation ecosystems, universities, public-private partnerships | Institutional foundations |
| **Mental Models** | Adaptability, resilience, urgency, experimentation, European integration | Behavioural drivers |
| **Purpose** | Improving living standards and creating opportunities for self-realisation | Long-term direction of transformation |

The significance of this analysis lies in its implications for collaboration. Many international initiatives focus primarily on the event level by supporting individual projects or technologies. The report argues that greater impact can be achieved by engaging with deeper structural and institutional layers where long-term transformation occurs.

### 7.1 Events: Visible Innovation Under Conditions of Disruption

The report identifies a remarkable number of visible innovations that have emerged during recent years. These include the Diia digital governance ecosystem, the Brave1 defence innovation platform, the WINWIN innovation strategy, municipal reconstruction programmes, energy resilience initiatives, and new forms of public-private collaboration.

Viewed individually, these initiatives appear to belong to different sectors. However, the report argues that they should be understood as manifestations of a broader transformation.

The common characteristic is not technological innovation itself. Rather, it is the emergence of systems capable of responding rapidly to urgent societal needs. Innovation increasingly becomes a tool for maintaining societal functionality under conditions of uncertainty.

This observation is particularly relevant for energy systems. Traditional energy innovation often focuses on technology development. Ukraine increasingly focuses on operational outcomes. The key question becomes whether hospitals remain functional, whether water systems continue operating, whether municipalities can maintain services, and whether citizens can access essential functions.

Such a perspective aligns closely with emerging international discussions concerning mission-oriented innovation and societal resilience.

## 7.2 Patterns: The Emergence of a Resilience-Oriented Innovation Culture

Beneath visible events, the report identifies recurring patterns that distinguish Ukraine's innovation ecosystem from many conventional systems.

Perhaps the most important pattern concerns the relationship between urgency and innovation. In many established innovation systems, long planning horizons, fragmented governance structures, and institutional risk aversion can slow implementation. Ukraine has increasingly developed mechanisms that reduce these barriers.

The result is an innovation culture characterised by rapid experimentation, continuous learning, close interaction between users and developers, and accelerated deployment cycles.

The report repeatedly highlights that this dynamic extends beyond defence innovation. Similar patterns can be observed in digital governance, healthcare innovation, municipal reconstruction, and increasingly in energy resilience programmes.

For Swedish actors, this observation is particularly important because it suggests that Ukraine may offer complementary capabilities rather than merely receiving expertise. Sweden possesses significant strengths in long-term planning, systems integration, institutional stability, and sustainability. Ukraine contributes practical experience in adaptation, rapid deployment, and innovation under conditions of uncertainty.

These complementary strengths create opportunities for mutual learning rather than one-directional knowledge transfer.

## 7.3 Structures: Institutional Foundations for Transformation

The report identifies several institutional structures that have become particularly influential in shaping Ukraine's innovation trajectory.

Among these, the Ministry of Digital Transformation occupies a central position. Established only a few years ago, the ministry has become internationally recognised for its role in developing digital public services, innovation platforms, and digital infrastructure.

The WINWIN initiative represents another important structural innovation. Rather than focusing narrowly on technology development, WINWIN seeks to create a comprehensive innovation ecosystem linking government, academia, business, civil society, and international partners.

The report emphasises that these structures should not be evaluated solely according to traditional innovation metrics. Their significance lies in their ability to coordinate actors around shared societal objectives.

**Table 4. Key Institutional Actors in Ukraine's Innovation Ecosystem**

| Institution | Primary Function | Strategic Relevance |
|---|---|---|
| **Ministry of Digital Transformation** | Digital governance and innovation policy | Coordination of digital transformation |
| **Ministry of Education and Science** | Research and talent development | Long-term innovation capacity |
| **WINWIN Platform** | Innovation ecosystem development | Strategic coordination |
| **Brave1** | Mission-oriented innovation | Rapid innovation deployment |
| **Diia Ecosystem** | Digital public services | Societal resilience and participation |
| **Municipal Governments** | Local implementation | Living laboratories for innovation |
| **Universities and Research Institutes** | Knowledge generation | Research and capability development |

The report argues that future collaboration should focus not only on technologies but also on strengthening these institutional foundations.

## 7.4 Mental Models: From Recovery to Opportunity

One of the most interesting aspects of the Iceberg analysis concerns the mental models shaping Ukraine's innovation ecosystem.

Many reconstruction processes are guided by a restoration mindset. The objective is to return to a previous state of normality. The report identifies a different perspective emerging in parts of Ukraine's innovation community. Rather than asking how to rebuild the past, many actors increasingly ask how reconstruction can create better futures.

This distinction shifts attention from repairing damaged infrastructure toward creating systems that are more resilient, more inclusive, more sustainable, and more supportive of human development than those they replace.

The report suggests that this mindset is visible in areas ranging from digital governance to urban planning, rehabilitation, and energy-system design.

For Sweden, this perspective aligns closely with contemporary discussions concerning systems innovation and mission-oriented transformation.

## 7.5 Purpose: The Significance of WINWIN 2030

The deepest layer of the Iceberg Model concerns purpose. Every system ultimately reflects assumptions regarding what it is trying to achieve.

The report identifies WINWIN 2030 as particularly important because it explicitly articulates a broader societal purpose for innovation policy.

Traditional innovation strategies frequently emphasise competitiveness, productivity, exports, investment, and economic growth. WINWIN certainly recognises the importance of these objectives. However, it also introduces a broader ambition.

Among its stated goals is the creation of opportunities for self-realisation of citizens. This formulation is significant because it implicitly shifts innovation policy toward questions traditionally associated with human development, wellbeing, and capability approaches.

**Table 5. Traditional Innovation Objectives and Emerging WINWIN Objectives**

| Traditional Innovation Logic | Emerging WINWIN Logic |
|---|---|
| **Economic growth** | Human development |
| **Competitiveness** | Self-realisation |
| **Productivity** | Capability expansion |
| **Technology deployment** | Societal transformation |
| **Innovation outputs** | Innovation outcomes |
| **Sectoral performance** | Quality of life |

The report argues that this shift may prove strategically important. As societies increasingly confront challenges related to ageing, mental health, social cohesion, climate adaptation, and resilience, innovation systems may need to demonstrate contributions to broader societal objectives rather than solely economic performance.

Suggested reading:

1. **Chapter 1 - Ukraine's Innovation ecosystem:** The Iceberg Model distinguishes events, patterns, structures, mental models and purpose, then applies those layers to the WINWIN strategy and Ukraine's innovation ecosystem.
2. **Chapter 2 - Ukraine's Innovation capacity and needs:** Government-actor mapping and the innovation-capacity SWOT provide structural evidence on ministries, municipalities, Diia, Brave1 and human-capability innovation.
3. **Chapter 11 - Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems:** Human-needs-driven delivery ecosystems distinguish innovation activity from societal outcomes and evaluate whether solutions improve wellbeing, resilience and opportunity.

## 8. Human-Needs-Driven Innovation Systems

The report's analysis ultimately converges on a broader question: what should innovation systems be designed to achieve? The answer proposed throughout the report is not technological progress for its own sake. Nor is it growth measured solely through conventional economic indicators.

Instead, the report repeatedly emphasises living standards, wellbeing, resilience, opportunities, and human development. Innovation becomes a means rather than an end. This perspective is particularly relevant for energy systems. Future energy systems are increasingly expected not merely to generate electricity but to support healthcare, education, housing, mobility, digital inclusion, and broader societal resilience.

The report therefore suggests that Ukraine may become an important environment for exploring human-needs-driven innovation systems in practice. Such systems seek to align technological innovation, institutional innovation, and societal outcomes around the objective of improving people's lives while strengthening long-term resilience.

This perspective provides an important framework for future collaboration between Sweden and Ukraine. The most valuable partnerships are unlikely to focus exclusively on individual technologies. Greater value is likely to emerge from initiatives that integrate energy, digitalisation, healthcare, urban development, and resilience around clearly defined societal objectives.

Suggested reading:

1. **Chapter 1 - Ukraine's Innovation ecosystem:** WINWIN's better-lives ambition can be operationalised by organising innovation around energy, health, mobility, housing and food outcomes rather than technology sectors alone.
2. **Chapter 2 - Ukraine's Innovation capacity and needs:** Superhumans and energy-as-system-integrator examples show how technology and services can be organised around restored capability, healthcare, housing, water and everyday wellbeing.
3. **Chapter 6 - Resilient energy systems in Ukraine:** Service-oriented resilience evaluates distributed energy by whether healthcare, water, sanitation, heating, housing and transport functions continue during disruption.

## 9. Strategic Implications for Sweden

The analysis presented in this chapter leads to several conclusions relevant for Swedish policymakers and funding agencies.

First, collaboration with Ukraine should increasingly focus on systems rather than projects. The most important opportunities lie in understanding how different components interact within broader societal systems.

Second, institutional innovation deserves attention alongside technological innovation. Ukraine's experience demonstrates that governance structures, coordination mechanisms, and innovation ecosystems can be as important as technical solutions.

Third, future collaboration should be framed around shared missions. Resilient energy systems, resilient cities, digital public infrastructure, and human-centred reconstruction all provide examples of missions capable of mobilizing diverse actors around common objectives.

Finally, the report suggests that Ukraine's greatest contribution may not be a specific technology or policy instrument. Rather, it may be the demonstration that innovation systems can be organised around human needs, resilience, and opportunities for self-realisation while simultaneously contributing to economic development and technological progress.

Suggested reading:

1. **Chapter 4 - Ongoing research & innovation collaborations: Ukraine- Sweden:** Existing Sweden–Ukraine cooperation works best around concrete societal needs and can advance by connecting, scaling and strategically aligning its fragmented initiatives.
2. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Complementary Swedish systems capabilities and Ukrainian resilience experience support mission-oriented bilateral instruments linking research, demonstration, implementation and municipal cooperation.
3. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Swedish support can be organised through energy guidance, resilient-energy research and a flourishing-city mission that combines reconstruction, security, human needs and export capacity.

# Part III. Ukraine's Innovation Ecosystem

## 10. The Emerging Architecture of Ukraine's Innovation Ecosystem

The report identifies a significant shift in the structure of Ukraine's innovation ecosystem. Historically, innovation systems have often been organised around relatively distinct sectors such as energy, transportation, healthcare, manufacturing, education, or information technology. The Ukrainian experience increasingly demonstrates the limitations of such compartmentalised approaches.

Many of the most important challenges currently facing Ukraine do not belong to a single sector. Energy resilience affects healthcare. Digital infrastructure affects energy security. Urban reconstruction influences economic development. Housing quality affects public health. Municipal governance shapes the effectiveness of infrastructure investments. As a result, Ukraine's most important innovation initiatives increasingly operate across sectoral boundaries.

**Table 6. Major Components of Ukraine's Innovation Ecosystem**

| Component | Primary Function | Strategic Relevance |
|---|---|---|
| **National Ministries** | Policy development and strategic coordination | System-wide transformation |
| **Municipal Governments** | Implementation and experimentation | Living laboratories |
| **Universities and Research Institutes** | Knowledge generation and talent development | Long-term capacity building |
| **Innovation Platforms** | Coordination and acceleration | Ecosystem development |
| **Private Sector** | Technology deployment and scaling | Market transformation |
| **International Partners** | Finance, expertise and cooperation | System acceleration |
| **Civil Society** | Social innovation and participation | Community resilience |

The report suggests that future success will depend increasingly on the ability to connect these components into functioning ecosystems rather than optimizing them individually.

Suggested reading:

1. **Chapter 1 - Ukraine's Innovation ecosystem:** Iceberg analysis identifies governance, funding, education, research and market structures behind Ukraine's innovation patterns and highlights the need for system redesign.
2. **Chapter 2 - Ukraine's Innovation capacity and needs:** Ukraine's innovation architecture spans ministries, municipalities, research, business and reconstruction actors whose distributed capacity requires stronger cross-sector coordination.
3. **Chapter 10 - Synergy and Acceleration Frameworks for Ukraine--Sweden Research and Innovation Cooperation:** Ukraine's multi-actor innovation ecosystem requires coordination infrastructure that links ministries, municipalities, startups, universities, donors, investors and research partners into learning portfolios.

## 11. National Leadership and Strategic Direction

The report identifies several national institutions as particularly important for shaping Ukraine's future innovation trajectory.

Among these, the Ministry of Digital Transformation occupies a uniquely influential position. Established as part of Ukraine's digital transformation agenda, the ministry has evolved into one of the country's most important innovation institutions. Its influence extends beyond digital services into entrepreneurship, innovation ecosystems, artificial intelligence, digital governance, and international collaboration.

The report repeatedly highlights the significance of Diia as both a practical platform and a symbol of institutional innovation. Diia demonstrates how digital infrastructure can support resilience, continuity of government services, entrepreneurship, and citizen participation even under conditions of severe disruption.

Alongside the Ministry of Digital Transformation, the Ministry of Education and Science plays a critical role in shaping future innovation capacity. The report emphasises that long-term competitiveness depends not only on technologies and infrastructure but also on human capital, research capabilities, and educational systems.

The Ministry of Energy and the Ministry for Development of Communities and Territories represent equally important partners from the perspective of reconstruction and energy-system transformation. Their responsibilities intersect directly with many of the themes identified as priorities for future Swedish–Ukrainian collaboration.

**Table 7. Priority National Partners**

| Institution | Research and innovation area |
|---|---|
| **Ministry of Energy** | Energy resilience, grid modernisation, storage, district heating |
| **Ministry of Digital Transformation** | Digital energy systems, AI, cybersecurity, digital twins |
| **Ministry of Education and Science** | Research cooperation and talent development |
| **Ministry for Development of Communities and Territories** | Reconstruction and municipal innovation |
| **WINWIN Platform** | Innovation ecosystem development |
| **Brave1** | Mission-oriented innovation methodologies |

The report suggests that these institutions should be understood not merely as administrative actors but as platforms through which broader ecosystem development occurs.

Suggested reading:

1. **Chapter 1:** WINWIN combines national coordination, 4 strategic pillars and 14 technology sectors with aims for living standards, inclusion and self-realisation.
2. **Chapter 2:** Government-actor mapping details the mandates, capacities and relationships of government and reconstruction institutions.
3. **Chapter 11:** WINWIN, the Diia ecosystem, etc. connect national innovation leadership to participation, resilience, entrepreneurship and self-realisation.

## 12. WINWIN and the Strategic Direction of Ukrainian Innovation

Among the initiatives examined in the report, WINWIN occupies a particularly important position because it provides a coherent narrative concerning the future direction of Ukrainian innovation policy.

Rather than framing innovation exclusively in terms of competitiveness or technological advancement, WINWIN introduces a broader societal perspective. The strategy seeks to strengthen living standards, improve opportunities for self-realisation, accelerate innovation, and position Ukraine as a globally relevant innovation nation.

This orientation is noteworthy because it aligns closely with broader international discussions concerning human-centred development and mission-oriented innovation. The report argues that WINWIN provides a bridge between traditional innovation policy and emerging approaches that place greater emphasis on societal outcomes.

For Swedish actors, WINWIN offers a particularly valuable entry point because it aligns with areas where Sweden already possesses internationally recognised expertise, including sustainability transitions, digital governance, urban innovation, healthcare innovation, and systems transformation.

The significance of WINWIN therefore extends beyond innovation policy itself. It functions as an organising framework capable of connecting diverse sectors and stakeholders around common societal objectives.

Suggested reading:

1. **Chapter 1 - Ukraine's Innovation ecosystem:** Assesses the WINWIN strategy through its better living standards ambition, structural strengths and tension between societal purpose and competitiveness-led implementation.
2. **Chapter 11 - Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems:** Explains WINWIN 2030's self-realisation objective and its shift from technological competitiveness towards human capabilities, societal outcomes and human-needs-driven delivery ecosystems.
3. **Chapter 10 – Synergy and Acceleration Frameworks for Ukraine–Sweden Research and Innovation Cooperation**: Proposes coordination frameworks that build on emerging WINWIN and Ukrainian digital-governance platforms to connect ministries, municipalities, startups, universities and international partners around shared transformation missions.

## 13. Municipalities as Platforms for Transformation

Perhaps the most important practical insight emerging from the report is the central role of municipalities.

While national strategies provide direction, implementation occurs largely at the local level. Cities and municipalities increasingly function as the environments in which reconstruction, energy-system transformation, digitalisation, housing development, mobility systems, and healthcare infrastructure converge.

The report highlights several municipalities as particularly relevant for future collaboration. Lviv occupies a prominent position because of its growing role as an innovation hub, rehabilitation centre, educational centre, and gateway for international collaboration. Kyiv remains central because of its role in national coordination, digital transformation, and infrastructure modernisation. Vinnytsia stands out because of its strong reputation for municipal governance and innovation. Kherson is highlighted because reconstruction challenges create opportunities for new approaches to resilience-oriented development.

**Table 8. Strategic Municipal Partners**

| Municipality | Strategic Strength |
|---|---|
| **Lviv** | Innovation, healthcare, international cooperation |
| **Kyiv** | Digital governance, energy modernisation |
| **Vinnytsia** | Municipal innovation and governance |
| **Kherson** | Resilience-oriented reconstruction |
| **Dnipro** | Industrial transformation |
| **Trostyanets** | Green reconstruction pilots |
| **Horenka** | Community-scale reconstruction |
| **Khotyn** | Sustainable rebuilding initiatives |

The report argues that municipalities should increasingly be understood as living laboratories capable of generating lessons relevant both for Ukraine and for international partners. Compact Recommendations 38 and 45 reinforce municipalities as recovery actors and identify sustainable twin-city partnerships as a practical route for international collaboration.

Suggested reading:

1. **Chapter 2 - Ukraine's Innovation capacity and needs:** Maps how municipalities connect services, reconstruction and innovation through specific city profiles and a distributed living-lab portfolio.
2. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Proposes municipal energy-management pilots and identifies Horenka, Trostyanets and Khotyn as potential green-reconstruction living laboratories that could integrate energy, housing, mobility, digital services and health outcomes.
3. **Chapter 11 - Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems:** Examines bilateral city partnerships linking Kherson's resilience needs with Umeå's wellbeing expertise and Vinnytsia's digital governance with Helsingborg's smart-city and energy innovation.

## 14. Ukraine's International Collaboration Landscape

The report identifies an unusually broad network of international collaborations. Ukraine is simultaneously engaging with the European Union, individual member states, multilateral institutions, international donors, development agencies, universities, companies, and civil society organisations.

European integration represents one of the most significant drivers of transformation. Alignment with European standards affects energy systems, digital governance, research policy, infrastructure planning, environmental regulation, and industrial development.

At the same time, international cooperation increasingly focuses on resilience rather than simply development. This distinction is important because resilience requires integrated approaches that combine technology, institutions, governance, and societal capacity. The report suggests that future collaborations are likely to become increasingly mission-oriented, bringing together diverse stakeholders around shared societal objectives.

**Table 9. International Collaboration Areas**

| Area | Current Focus | Future Opportunity |
|---|---|---|
| **Energy** | Reconstruction and security | Resilient energy systems |
| **Digitalisation** | Public services | AI-enabled governance |
| **Research** | Capacity building | Joint innovation ecosystems |
| **Cities** | Reconstruction support | Living laboratories |
| **Healthcare** | Emergency support | Human-centred innovation |
| **Industry** | Recovery | Green industrial transformation |

Suggested reading:

1. **Chapter 3 - Ongoing research & innovation collaborations: EU:** Maps EU–Ukraine cooperation through Horizon Europe, ERA integration, sectoral partnerships and reconstruction-linked funding, including lessons and future integration opportunities.
2. **Chapter 4 - Ongoing research & innovation collaborations: Ukraine- Sweden:** Maps the Sweden–Ukraine collaboration landscape across policy frameworks, university partnerships, applied innovation, capacity building and sector projects, with opportunities for stronger portfolio coordination.
3. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Proposes integrated Sweden–Ukraine innovation missions spanning resilient energy, reconstruction, digitalisation, cybersecurity, civil preparedness and human-centred systems.

## 15. Sweden's Strategic Position

The report devotes particular attention to Sweden because of the unusually strong complementarity between Swedish and Ukrainian capabilities.

Sweden's strengths are not limited to specific technologies. The report highlights broader capabilities related to systems integration, governance, sustainability transitions, urban development, district heating, digitalisation, and innovation management.

Ukraine contributes a different but equally valuable set of capabilities. These include rapid deployment, resilience under uncertainty, adaptive governance, mission-driven innovation, engineering talent, and large-scale experimentation.

**Table 10. Complementary Capabilities**

| Swedish Strengths | Ukrainian Strengths |
|---|---|
| **Systems integration** | Rapid deployment |
| **District heating** | Resilience under uncertainty |
| **Urban sustainability** | Adaptive governance |
| **Innovation management** | Mission-driven innovation |
| **Municipal governance** | Engineering talent |
| **Industrial transformation** | Real-world testing environments |
| **Long-term planning** | Accelerated learning cycles |

This complementarity suggests that collaboration should be structured as mutual learning rather than traditional donor-recipient relationships.

Suggested reading:

1. **Chapter 4 - Ongoing research & innovation collaborations: Ukraine- Sweden:** Pairs Swedish strengths in digital government, energy, sustainability, public administration, life sciences and AI with Ukrainian use cases, technical communities and European integration.
2. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Analyses complementary Ukrainian resilience and deployment capabilities and Swedish systems integration, municipal governance and sustainability expertise through a proposed dual-testbed model.
3. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Makes the case for mutual learning and co-development by combining Sweden's institutional, municipal and district-heating strengths with Ukraine's rapid deployment and operational resilience.

# Part IV. Energy, Resilience and Reconstruction

## 16. Strategic Opportunities

The report identifies several areas where Swedish engagement could create particularly high value.

Among these, resilient energy systems stand out as the most important. Ukraine's experience with energy infrastructure disruption creates opportunities to develop globally relevant knowledge concerning distributed generation, storage systems, microgrids, district heating resilience, digital energy management, and service continuity.

A second opportunity concerns municipal energy systems. Swedish municipalities have extensive experience with district heating, energy planning, urban sustainability, and public-sector innovation. Ukrainian municipalities provide environments where these capabilities can be tested and adapted under highly demanding conditions.

A third opportunity concerns the integration of digital and energy systems. The combination of Ukraine's digital governance capabilities and Sweden's expertise in energy systems creates opportunities for collaboration involving digital twins, AI-supported energy management, predictive maintenance, and resilience monitoring.

The report suggests that the greatest value is likely to emerge from integrated programmes rather than isolated projects. Such programmes should combine research, demonstration, implementation, monitoring, and policy learning.

Suggested reading:

1. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Structures an integrated bilateral programme around municipal energy resilience, digital energy and AI, reconstruction, pilots, research calls and three connected portfolios.
2. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Proposes financeable Sweden–Ukraine demonstrators for hospital, water, housing and heat resilience, municipal energy management and cross-cutting resilience monitoring.
3. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Identifies opportunities for global leadership in distributed energy, AI-enabled resilience, digital twins and human-centred reconstruction through calls, testbeds and a staged roadmap.

## 17. Strategic Implications

The stakeholder analysis presented throughout the report leads to a broader conclusion. Ukraine's innovation ecosystem is not defined primarily by any individual institution, city, or technology. Its defining characteristic is the emergence of networks capable of linking diverse actors around common societal objectives.

Greater value is likely to emerge from initiatives that engage with the broader ecosystem and recognise the interconnected nature of energy, digitalisation, governance, healthcare, urban development, and resilience.

Ukraine's significance therefore lies not only in what it is rebuilding but also in how it is rebuilding. The country's experience offers insights into how innovation ecosystems can operate under conditions of uncertainty, how reconstruction can become transformation, and how energy systems can contribute to broader societal objectives. These insights have relevance far beyond Ukraine itself and suggest substantial opportunities for long-term collaboration between Ukrainian and Swedish actors.

Suggested reading:

1. **Chapter 1 - Ukraine's Innovation ecosystem:** Ukraine's innovation ecosystem can connect international partnerships and daily life systems so technological progress produces tangible wellbeing outcomes.
2. **Chapter 2 - Ukraine's Innovation capacity and needs:** Mutual collaboration can combine complementary capabilities in resilient energy, healthcare and human-centred reconstruction to generate knowledge for both countries.
3. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** A mission-oriented programme can integrate research institutions, municipalities, utilities, startups and industrial actors through municipal cooperation and long-term bilateral networks.

## 18. From Energy Security to Energy Resilience

The report argues that conventional energy-security frameworks are increasingly insufficient for understanding contemporary risks.

Historically, energy security focused primarily on fuel supply, generation capacity, transmission reliability, and market stability. While these dimensions remain important, Ukraine demonstrates that modern societies face a wider range of vulnerabilities. Cyberattacks, infrastructure attacks, climate-related disruptions, supply-chain interruptions, and failures within digital systems all influence the ability of energy systems to support societal functions.

As a consequence, the report proposes a broader resilience perspective. Energy resilience refers not only to the capacity to continue generating electricity. It refers to the capacity of societies to maintain essential services despite disruption. This distinction is fundamental because it shifts attention away from individual technologies and toward the interaction between infrastructure, institutions, governance systems, communities, and users.

**Table 11. Evolution of Energy-System Thinking**

| Traditional Energy Security | Resilient Energy Systems |
|---|---|
| **Fuel supply** | Service continuity |
| **Generation capacity** | Societal functionality |
| **Grid reliability** | Adaptive capability |
| **Infrastructure protection** | System recovery |
| **Asset management** | Human-centred outcomes |
| **Technical performance** | Resilience of essential services |

The report suggests that this broader understanding of resilience should guide future research programmes and demonstration activities.

Suggested reading:

1. **Chapter 2 - Ukraine's Innovation capacity and needs:** Energy should be treated as a life-support system assessed through public health, service continuity and local resilience rather than supply infrastructure alone.
2. **Chapter 5 - Energy research & innovation, priorities and needs:** Distributed architectures should maintain critical services, fail gracefully and recover rapidly when the central grid is disrupted.
3. **Chapter 6 - Resilient energy systems in Ukraine:** Energy resilience is a system's ability to anticipate, withstand, adapt to and recover from disruption while ensuring continuity of essential services.

## 19. Why Ukraine Matters for Future Energy Research

Many of the challenges currently facing Ukraine are likely to become increasingly relevant across Europe during coming decades.

Climate-related disruptions are expected to increase. Digitalisation is increasing dependence on data systems and communications infrastructure. Electrification is increasing dependence on reliable energy supply. Geopolitical instability has reintroduced concerns regarding infrastructure security and strategic resilience.

Ukraine therefore functions as a large-scale testing environment for future energy-system challenges. Importantly, the report does not present Ukraine as a unique exception. Rather, it suggests that Ukraine may be experiencing today many of the systemic challenges that other countries will encounter in different forms tomorrow.

For research funders, this creates significant opportunities. Projects implemented in Ukraine can simultaneously support reconstruction while generating knowledge relevant to Sweden, the European Union, and other advanced economies. This dual benefit distinguishes Ukraine from many conventional demonstration environments.

Suggested reading:

1. **Chapter 5 - Energy research & innovation, priorities and needs:** Ukraine is a global testbed for applied research on distributed architectures that maintain critical services under deliberate attack.
2. **Chapter 6 - Resilient energy systems in Ukraine:** Ukraine is an unprecedented real-world laboratory where rarely studied attacks enable modern energy-system research on resilience.
3. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Funded demonstrators can connect decentralised energy systems to measurable continuity of essential services through applied research, municipal pilots and replication packages.

## 20. Healthcare as an Energy Resilience Priority

The report identifies healthcare as one of the strongest existing examples of energy resilience implementation.

Several projects have already demonstrated how distributed energy systems can improve the resilience of hospitals and healthcare facilities. Solar generation, battery storage, hybrid systems, backup architectures, and energy-management systems are increasingly being deployed to ensure continuity of healthcare services during disruptions.

The significance of these projects extends beyond healthcare itself. Hospitals provide an ideal environment for studying resilience because failures have immediate consequences. The continuity of healthcare services can therefore serve as a measurable indicator of system performance.

Healthcare resilience offers an opportunity to combine expertise from energy systems, digital systems, healthcare management, building performance, and resilience science.

**Table 12. Potential Sweden–Ukraine Health Service Resilience Programme**

| Component | Swedish Contribution | Ukrainian Contribution |
|---|---|---|
| **Solar and storage systems** | Technology integration | Operational experience |
| **Energy management systems** | Digital optimisation | Real-world deployment |
| **Healthcare infrastructure** | Research and evaluation | Implementation environments |
| **Resilience monitoring** | Analytical frameworks | Operational data |
| **Long-term scaling** | System design | Demonstration sites |

Potential partners include the Ministry of Health, Superhumans Center, Energy Act for Ukraine Foundation, Karolinska Institutet, RISE, regional healthcare authorities, and selected municipalities.

Suggested reading:

1. **Chapter 5 - Energy research & innovation, priorities and needs:** Applied research should test microgrids for hospitals and hybrid systems combining solar, batteries and efficient heating to maintain critical services.
2. **Chapter 6 - Resilient energy systems in Ukraine:** Healthcare resilience can be measured through outage hours, critical medical equipment remaining operational, avoided cancellations and autonomous operation.
3. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Healthcare is the strongest documented area of decentralised energy deployment, supporting continuity of healthcare functions during outages.

## 21. Water Infrastructure and Essential Services

The report identifies water infrastructure as another particularly important area. Water and wastewater systems depend heavily on energy supply. Disruptions can rapidly affect public health, sanitation, emergency response, and municipal operations.

Projects involving solar-powered water utilities, energy-efficient pumping systems, battery storage, wastewater modernisation, and distributed backup systems have already been implemented in several Ukrainian municipalities. The report suggests that these initiatives represent an important opportunity for future research.

While substantial attention has been devoted to electricity systems, comparatively little research has examined how energy resilience contributes to water-service continuity. Ukraine therefore offers an opportunity to develop internationally relevant knowledge concerning the relationship between energy systems and essential municipal services.

**Table 13. Research Questions for water Infrastructure and Essential Services**

| Energy challenge | Impact on water services | Research opportunity | Strategic value |
|---|---|---|---|
| **Power disruptions** | Water supply and wastewater systems stop functioning | Study how resilient energy systems ensure continuity of essential services | Knowledge for future resilient cities |
| **Existing solutions** | Solar-powered utilities, battery storage, energy-efficient pumping, distributed backup systems | Evaluate performance under real-world conditions | Evidence for resilient infrastructure design |
| **Knowledge gap** | Limited research on the energy–water relationship | Develop integrated energy–water resilience models | New knowledge relevant for Sweden, the EU, and other countries |
| **Long-term outcome** | Secure water, sanitation, and municipal services during crises | Integrated urban resilience research | Stronger critical infrastructure and societal resilience |

This area aligns strongly with interests in critical infrastructure resilience and integrated urban systems.

Suggested reading:

1. **Chapter 2 - Ukraine's Innovation capacity and needs:** Reliable energy supports water, wastewater and sanitation through solar-powered utilities, pumping-station upgrades and wastewater modernisation.
2. **Chapter 6 - Resilient energy systems in Ukraine:** Water supply can maintain pumping and treatment through solar PV, storage and pump controls, while wastewater systems maintain sanitation functions.
3. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Water utility demonstrators should combine solar-powered water utilities, pump optimisation, digital monitoring and service-continuity assessment.

## 22. District Heating and Thermal Resilience

Among all energy-related topics discussed in the report, district heating may represent the strongest area of complementarity between Sweden and Ukraine.

Ukraine possesses extensive district-heating infrastructure. Much of this infrastructure requires modernisation, and reconstruction creates opportunities to introduce new technologies and new operating models.

The report identifies several promising directions including heat pumps, thermal storage, hybrid systems, low-temperature district-heating networks, cogeneration modernisation, and municipal heat resilience.
The importance of this area extends beyond emissions reduction. Thermal resilience is directly linked to public health, quality of life, and societal stability. In cold climates, failures within heating systems can rapidly create severe consequences.

**Table 14. Research Questions for District Heating**

| Research Theme | Strategic Relevance |
|---|---|
| **Thermal storage** | Improved resilience during disruptions |
| **Heat pumps** | Reduced dependence on fuel supply |
| **Hybrid heating systems** | Increased flexibility |
| **Low-temperature networks** | Improved efficiency and resilience |
| **District-heating digitalisation** | Better monitoring and control |
| **Thermal resilience metrics** | Improved planning and evaluation |

The report suggests that Ukraine could become one of Europe's most important demonstration environments for future district-heating systems.

Suggested reading:

1. **Chapter 2 - Ukraine's Innovation capacity and needs:** Frames district heating and thermal resilience as a flagship mission linking heat pumps, storage integration and municipal planning to warm homes, public health and service continuity.
2. **Chapter 5 - Energy research & innovation, priorities and needs:** Specifies research and demonstration priorities for district heating and heat resilience, including low-temperature networks, heat pumps, thermal storage and hybrid systems.
3. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Combines implemented heating evidence with proposed thermal-resilience demonstrators using local generation, heat pumps, thermal storage, district-heating flexibility and emergency-operation strategies.

## 23. Municipal Energy Management and Digital Energy Systems

The convergence of digitalisation and energy systems emerges as another major theme. Ukraine's digital transformation creates opportunities to explore how municipalities can use digital platforms, energy-management systems, distributed storage, predictive analytics, and artificial intelligence to improve resilience.

The report notes that regulatory and institutional foundations for flexibility systems, storage integration, and digital energy management are already emerging. For Sweden, this area aligns with strengths in smart energy systems, digital twins, municipal energy planning, and data-driven decision making.

The combination of Sweden's experience with advanced energy systems and Ukraine's experience with digital transformation creates strong opportunities for collaboration. The Compact also suggests that digital systems can support public transparency and participatory environmental monitoring, including through tools such as EcoZagroza.

**Table 15. Research Questions for Energy Management and Digital Energy Systems**

| Digital energy challenge | Emerging solutions | Research opportunity | Strategic value |
|---|---|---|---|
| **Growing need for resilient municipal energy management** | Digital platforms, energy management systems, distributed storage, predictive analytics, AI | Study how digital tech improve the resilience and flexibility of municipal energy systems | Knowledge for future smart and resilient energy systems |
| **Emerging regulatory and institutional frameworks** | Flexibility markets, storage integration, digital energy management | Evaluate new governance models and digital tools in real-world settings | Evidence for next-generation energy management |
| **Complementary strengths** | **Ukraine:** Digital transformation and rapid implementation<br>**Sweden:** Smart energy systems, digital twins, municipal energy planning, data-driven decisions | Joint development and demonstration of integrated digital energy solutions | Accelerated Sweden–Ukraine collaboration and innovation |
| **Long-term outcome** | Smarter, more adaptive municipalities | Integrated digital and energy systems | More resilient cities, future-ready energy infrastructure |

Potential partners include the Ministry of Digital Transformation, WINWIN AI Center of Excellence, Lviv IT Cluster, KTH, Chalmers University of Technology, AI Sweden, and RISE.

Suggested reading:

1. **Chapter 5 - Energy research & innovation, priorities and needs:** Specifies digital energy systems research priorities in grid digital twins, AI-enabled forecasting, secure interoperable data and cybersecurity for distributed infrastructure.
2. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Connects operational energy-management evidence to proposed municipal flexibility pilots combining distributed storage, controllable demand and critical-load protection.
3. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Identifies Sweden–Ukraine leadership opportunities in AI-supported energy planning, cybersecure grids and digital twins, and proposes calls for municipal resilience.

## 24. Energy-Positive Reconstruction and Living Laboratories

One of the report's most forward-looking ideas concerns the concept of reconstruction as a living laboratory. Rather than viewing reconstruction projects solely as infrastructure investments, the report suggests that they should also function as research environments capable of generating evidence concerning resilience, wellbeing, sustainability, and quality of life.

Several locations, including Horenka, Trostyanets, and Khotyn, are highlighted as particularly promising environments for experimentation. The report argues that future reconstruction initiatives should integrate energy systems, housing, mobility, healthcare, digital services, and local economic development rather than addressing these domains separately.

This perspective aligns closely with Swedish experience concerning sustainable urban development and innovation districts.

**Table 16. Potential Living Laboratory Themes**

| Theme | Potential Outcomes |
|---|---|
| **Energy-positive neighbourhoods** | Reduced emissions and increased resilience |
| **Integrated mobility systems** | Improved accessibility and quality of life |
| **Smart municipal services** | Better resource efficiency |
| **Community resilience systems** | Stronger societal adaptation |
| **Digital infrastructure** | Enhanced continuity of services |
| **Human-centred reconstruction** | Improved wellbeing outcomes |

The report suggests that such projects could become internationally significant examples of integrated reconstruction.

Suggested reading:

1. **Chapter 5 - Energy research & innovation, priorities and needs:** Sets out a research and demonstration agenda for energy-positive reconstruction through deep renovation, high-performance buildings, heat pumps and district-level energy systems.
2. **Chapter 7 - Pathways for resilient energy systems in Ukraine:** Identifies Horenka, Trostyanets and Khotyn as evidence-bounded green reconstruction opportunities for prospective living laboratories integrating energy, housing, mobility, health, digital services and local development.
3. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Proposes a Flourishing City Reconstruction Mission as a replicable living laboratory for resilient energy, housing, mobility, healthcare, digital services and quality of life.

# Part V. Future Collaboration Between Sweden and Ukraine

## 25. Future Research Calls

The report provides a strong argument for moving beyond conventional technology-specific calls. Future programmes should increasingly be organised around societal missions and resilience outcomes. This shift would encourage interdisciplinary collaboration and create stronger links between research, implementation, and policy development. Across these calls, the Compact supports common criteria for human outcomes, environmental performance, monitoring and avoidance of significant environmental harm.

**Table 17. Possible Research Calls**

| Call Theme | Strategic Objective | Potential Ukrainian Partners |
|---|---|---|
| **Resilient Healthcare Infrastructure** | Maintain healthcare continuity during disruptions | Ministry of Health, Superhumans Center |
| **Resilient Municipal Energy Systems** | Strengthen local resilience capabilities | Municipalities, Ministry for Communities and Territories |
| **District Heating Transformation** | Modernise thermal systems | Naftogaz, municipal heating companies |
| **AI and Digital Energy Systems** | Improve adaptability and efficiency | Ministry of Digital Transformation, WINWIN AI CoE |
| **Water-Energy Resilience** | Protect essential services | Municipal water utilities |
| **Energy-Positive Reconstruction** | Develop future reconstruction models | Horenka, Trostyanets, Khotyn municipalities |

Suggested reading:

1. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Proposes dedicated Sweden–Ukraine mission-oriented calls combining applied research, demonstration and implementation across resilient energy, district heating, AI, storage and municipal resilience.
2. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Specifies bilateral call designs for resilient daily-life energy services and fossil-free reconstruction linked to pilots, innovation clusters and human outcomes.
3. **Chapter 2 - Ukraine's Innovation capacity and needs:** Provides a mission-portfolio rationale for long-term calls integrating research, innovation, deployment, infrastructure, shared funding and testbeds around resilience outcomes.

## 26. Strategic opportunities

The report ultimately suggests that other countries should move beyond viewing Ukraine primarily as a reconstruction challenge. Instead, Ukraine should be understood as a strategic partner in the development of future energy systems.

The strongest opportunities arise where reconstruction needs intersect with globally relevant research questions. Resilient healthcare systems, thermal resilience, municipal energy management, digital energy systems, critical infrastructure protection, and human-centred reconstruction all satisfy this criterion.
The report therefore supports the establishment of a long-term Sweden–Ukraine programme for resilient energy systems. Such a programme should combine research funding, demonstration projects, municipal partnerships, industrial collaboration, and policy learning. Its purpose should not merely be to support reconstruction but to generate internationally relevant knowledge concerning the future of resilient and human-centred energy systems.

The strategic opportunity is therefore larger than Ukraine itself. The country provides an environment in which future challenges can be studied, future solutions can be tested, and future energy systems can be developed under conditions that reveal both their strengths and their weaknesses. Few opportunities currently available in Europe offer a similar combination of practical relevance, scientific value, and long-term strategic importance.

**Table 18. Strategic opportunities**

| From… | To… | How? | Long-term value |
|---|---|---|---|
| **Viewing Ukraine primarily as a reconstruction challenge** | Viewing Ukraine as a strategic partner for future energy research | Long-term Sweden–Ukraine programme combining research, demonstration projects, municipal partnerships, industry collaboration, and policy learning | Internationally relevant knowledge for resilient and human-centred energy systems |
| **Reconstruction needs** | Globally relevant research questions | Research on healthcare resilience, thermal resilience, municipal energy management, digital energy systems, critical infrastructure, and human-centred reconstruction | Solutions applicable across Sweden, Europe, and beyond |
| **National recovery** | Shared innovation and learning | Test future energy systems under real-world conditions | Stronger, more resilient energy and innovation systems |

Suggested reading:

1. **Chapter 8 - Global leadership through Ukraine-Sweden collaboration:** Proposes a long-term Sweden–Ukraine partnership combining research calls, demonstrations, municipal cooperation, industry, finance and policy for resilient energy systems.
2. **Chapter 9 - Possible structure for research- and innovation collaboration between Ukraine-Sweden:** Proposes three Sweden–Ukraine collaboration portfolios for energy guidance, resilient reconstruction research and a flagship flourishing-city mission based on mutual learning.
3. **Chapter 2 - Ukraine's Innovation capacity and needs:** Identifies strategic priorities for long-term mission portfolios, municipal innovation and mutual Sweden–Ukraine learning in resilient, human-centred energy systems.

# Detailed Findings and Analysis

# Introduction

Ukraine today represents one of the most extreme societal environments in Europe for research, innovation, and reconstruction. The country is simultaneously experiencing war, large-scale destruction, demographic disruption, and economic pressure, while also maintaining functioning institutions, scientific capabilities, digital governance systems, and rapidly evolving innovation ecosystems. Millions of people have been displaced, large parts of the country's infrastructure have been damaged, and approximately 23% of the territory is estimated to be contaminated by mines or explosive remnants of war. Despite these conditions, Ukraine continues not only to rebuild, but also to experiment with new forms of resilience, technology deployment, rehabilitation, energy systems, and public-sector innovation.

This creates an innovation environment fundamentally different from stable countries such as Sweden. In Ukraine, constant disruption, urgency, and operational pressure are part of everyday reality. Innovation cycles are compressed, stakeholders collaborate in new ways, and solutions often need to move from concept to implementation in days rather than years. As expressed by the founder of the rehabilitation initiative Superhumans: "Here in Ukraine we do not buy hard avocados." The phrase captures the speed, immediacy, and mission-oriented character of Ukrainian innovation under wartime conditions.

At the same time, Ukraine's innovation ecosystem is not only focused on survival and repair. Alongside efforts to restore damaged infrastructure and maintain societal functions, new future-oriented initiatives are emerging that combine technological innovation with long-term visions for human wellbeing, resilience, and societal transformation. These innovation hotspots are not isolated islands of progress in the middle of chaos, but rather ships operating in a storm, where adaptability, collaboration, and hope become central innovation capabilities. Understanding these dynamics is important not only for Ukraine's future reconstruction, but also for broader discussions about resilience, mission-driven innovation, and how societies can transform under extreme pressure.

**Ukraine and an extreme context for research and innovation**

Ukraine today exists under conditions that are extraordinarily difficult to fully understand from outside the country. Since the full-scale Russian invasion in February 2022, the country has experienced continuous missile attacks, destruction of civilian infrastructure, mass displacement, economic disruption, loss of life, and prolonged societal insecurity. Millions of people continue to live under conditions where air raid alarms, power outages, uncertainty, and trauma are part of everyday life.

The scale of disruption is enormous. Before the full-scale invasion, Ukraine had a population of approximately 41–44 million people. Today, an estimated 6.7 million Ukrainians remain abroad as refugees, while around 3.7 million are internally displaced. Approximately 23% of Ukraine's territory is estimated to be contaminated by mines or explosive remnants of war, creating one of the world's largest demining challenges. More than 1,400 scientific buildings and hundreds of pieces of scientific equipment have been damaged or destroyed. At the same time, large parts of the country's energy infrastructure have been repeatedly targeted through strategic attacks.

**Ukraine and Sweden: Context for Research and Innovation**

| Indicator | Ukraine before full-scale war (2021) | Ukraine during war (2024–2026) | Sweden (2024–2026) |
|---|---|---|---|
| Population | 41–44 million | ~38 million* | ~11 million |
| Refugees / displaced population | No mass displacement | ~6.7 million abroad;* ~3.7 million displaced* | Primarily host country |
| Territory contaminated by mines/explosives | Limited contamination | ~23%* | Negligible |
| Military expenditure (% GDP) | ~3–4% | ~34.5%* | ~2.0% |
| R&D expenditure (% GDP) | ~0.4–0.5% | ~0.32–0.37%* | ~3.4% |
| GDP (current US$) | ~US$200 bn | ~US$190 bn* | ~US$600 bn |
| GDP per capita | ~US$4,800 | ~US$5,400* | ~US$57,000 |
| Scientific infrastructure damaged | Stable national infrastructure | >1,400 scientific buildings* | No comparable destruction |
| Energy infrastructure attacks | None | Repeated strategic attacks on grid and heating systems | Stable infrastructure |
| EU status | Partnership ambitions | EU candidate country under war conditions | EU member |

The economic context is equally extreme. Ukraine's military expenditure has increased to approximately 34.5% of GDP, compared with roughly 2% in Sweden. Despite this, the country continues to maintain research institutions, industrial production, public administration, digital governance systems, and educational structures. Ukraine therefore represents a highly unusual environment where societal survival, reconstruction, defence, and future-oriented transformation occur simultaneously.

This context differs fundamentally from Sweden. Sweden operates within a stable institutional environment with approximately 3.4% of GDP invested in research and development, strong public institutions, stable infrastructure, and long-term planning horizons. Ukraine, by contrast, operates under conditions where disruption is constant and uncertainty is part of normality.

**Extreme Conditions Driving Extreme Innovation**

Within this environment, remarkable forms of innovation have emerged. Ukraine has become one of the world's most intense environments for rapid experimentation, adaptation, and deployment of new technologies, organisational models, and resilience systems.

In many sectors, innovation cycles that might normally take years are compressed into weeks or months. Stakeholders collaborate across public institutions, military structures, civil society, international actors, start-ups, and local communities in ways rarely seen in more stable environments. Speed, operational relevance, and adaptability become more important than perfection or long-term optimisation.

Most of this innovation is directly linked to urgent wartime needs. Large efforts are focused on repairing damaged infrastructure, restoring energy systems, rebuilding housing, maintaining logistics, supporting healthcare systems, and ensuring continuity of public services. In this sense, much of Ukraine's innovation ecosystem is shaped by repair, resilience, and survival.

At the same time, a smaller but highly important subset of initiatives goes beyond repair and focuses on creating entirely new systems and visions for the future. These initiatives are not only significant from technological, economic, or organisational perspectives. They also play a critical societal role by providing hope, dignity, direction, and long-term imagination in the middle of war.

This combination of immediate operational urgency and future-oriented transformation makes Ukraine a uniquely important environment for understanding next-generation innovation systems.

**Innovation Hotspots: Ships in a Storm**

Some of the clearest examples of this new innovation logic can be found in emerging innovation hotspots such as Superhumans, based in Lviv. Superhumans is a rehabilitation and prosthetics centre focused on supporting people injured by the war through advanced prosthetics, reconstructive surgery, rehabilitation, and psychological support. However, it is more than a healthcare initiative. It represents a broader model where technology, dignity, social reintegration, design, international collaboration, and future-oriented institution building are combined under conditions of extreme urgency.

The founder of Superhumans described the Ukrainian innovation environment through a simple phrase: "Here in Ukraine we do not buy hard avocados."

The statement captures a deeper reality about how innovation functions during war. In many stable societies, innovation systems are built around long planning cycles, gradual implementation, institutional predictability, and incremental deployment. In Ukraine, solutions often need to work immediately. The distance between identifying a problem and deploying a solution can be measured in days rather than years.

These innovation hotspots should therefore not be understood as isolated islands of innovation surrounded by chaos. They are better understood as ships operating in the middle of a storm. Constant disruptions, changing conditions, infrastructure failures, emotional pressure, and existential urgency are part of the operational environment. Stakeholders interact differently. Decision-making structures change rapidly. Learning cycles are accelerated. User needs are immediate and deeply human.

This creates a very different innovation culture compared to countries such as Sweden. In Sweden, innovation systems often benefit from institutional stability, long-term funding structures, predictable infrastructure, and lower levels of operational risk. Ukraine instead demonstrates how innovation ecosystems can function under extreme pressure where resilience, improvisation, urgency, and mission orientation become central capabilities.
At the same time, these Ukrainian innovation environments are not purely reactive. Alongside repair and reconstruction, they also contain visions for a better tomorrow. New rehabilitation systems, energy systems, digital governance tools, reconstruction approaches, and urban-development concepts are emerging that may influence not only Ukraine's future, but also how Europe and the wider world think about resilience, human-centred innovation, and societal transformation.

Ukraine therefore represents not only a humanitarian and geopolitical challenge, but also a profoundly important environment for understanding how research and innovation systems evolve under extreme conditions, how societies rebuild under pressure, and how hope itself can become an innovation driver.

# 0. Methodology

## 0.1. Purpose of the work

The assignment was carried out to identify opportunities for strengthened Swedish–Ukrainian collaboration in research and innovation related to the energy transition, reconstruction and long-term societal resilience. The work combined strategic analysis with broad stakeholder engagement to identify areas where collaboration could create the greatest value for both countries.

Rather than relying on a single study or workshop, the report was developed through an iterative process involving literature review, expert dialogue, bilateral meetings, workshops, internal quality assurance and continuous refinement of the analytical framework.

## 0.2. Research questions

The work was guided by five overarching questions:

1. Which Ukrainian strengths within research and innovation are most relevant for future collaboration with Sweden?
2. Which innovation ecosystems are emerging during reconstruction?
3. Which Swedish capabilities complement Ukrainian priorities?
4. Which concrete collaborations could generate long-term societal, industrial and energy-system benefits?
5. How can research and innovation contribute simultaneously to reconstruction, competitiveness and resilience?

## 0.3. Analytical approach

The analysis combined several complementary sources of evidence.

**Desk research:** Scientific literature, policy documents, government strategies, innovation programmes and public reports from Sweden, Ukraine and international organisations were reviewed.
**Expert consultation:** Findings were continuously discussed with experts from government agencies, research institutes, innovation organisations, universities, companies and international networks.
**Iterative workshops and working meetings:** Rather than one single workshop, the work consisted of a series of structured smaller workshops, planning meetings and thematic discussions where preliminary findings were tested, refined and prioritised.
**Continuous synthesis**: Insights from meetings and literature were continuously integrated into successive versions of the report.

## 0.4. Data collection

Data collection took place continuously, but with the following focus areas over time:

| Period | Main activity |
|---|---|
| e/o March 2026 | Project initiation, Ukraine overview discussions, innovation scoping. |
| April 2026 | Kick-off for innovation mapping, Ukraine planning meetings, coordination with Vinnova, first delivery discussions, recurring Ukraine project meetings, energy seminars, innovation mapping, framework development. |
| May 2026 | Coordination meetings, Superhumans discussions, Umeå collaboration, innovation partnership meetings, interdisciplinary seminars. |
| June 2026 | Draft reviews, report synchronisation meetings, final reporting meetings, delivery finalisation. |

To provide depth many of the stakeholders were consulted multiple times during the process rather than isolated consultations.

## 0.5. Workshops and expert dialogue

The project relied primarily on **working workshops**, **coordination workshops** and **expert dialogue sessions** rather than large public workshops.

Examples include:

- Internal kick-off workshop in RISE for the innovation mapping
- Ukraine planning meetings
- Coordination meetings with Vinnova
- Innovation partnership discussions
- City workshop
- New innovations opportunity workshop (Superhumans collaboration discussions)
- Internal RISE review workshop
- Draft review meetings
- Final reporting meetings

These meetings served different purposes during the project:

| Purpose | Typical use |
|---|---|
| Scoping | Identify important themes and actors |
| Validation | Test emerging findings |
| Prioritisation | Compare possible recommendations |
| Quality assurance | Challenge assumptions and improve robustness |
| Integration | Merge insights into later report versions |

## 0.6. Expert contributions

The calendar demonstrates that the work involved dialogue with representatives from several categories of organisations. These include:

**Swedish public organisations:** Swedish Energy Agency**,** Vinnova**,** RISE.

**Ukrainian actors:** Ukrainian innovation initiatives**,** traditonal innovation ecosystem stakeholders**,** city stakeholders**,** reconstruction stakeholders, next generation innovation stakeholders.
**Innovation ecosystems:** Discussions with innovation programmes, regional innovation actors and international collaboration initiatives.

## 0.7. Quality assurance

The report was not written sequentially but developed through several iterative review cycles. The calendar included: planning meetings, interim deliveries, draft review meetings, recurring project synchronisation, final reporting meetings, internal discussions before submission.

These repeated review cycles contributed to improving consistency, identifying missing perspectives and validating recommendations before final delivery.

## 0.8. Limitations

The work took place during only 14 weeks and with Ukraine in significant flux, and some planned follow-up meetings were irrelevant as people moved on the work should be understood as a strategic innovation mapping rather than a comprehensive review of all Ukrainian research organisations. Some recommendations necessarily reflect emerging opportunities that continue to evolve rapidly as reconstruction progresses.

## 0.9. Experts and workshop participants contributing to the report

The development of *Ukraine and Innovations for Tomorrow* was informed by a series of workshops and discussions bringing together experts from Ukraine, Sweden and international organisations. Participants contributed perspectives on Ukraine's emerging innovation ecosystem, resilient cities and infrastructure, human-needs-driven innovation, and opportunities for future Sweden-Ukraine collaboration.

The workshops were organised around different parts of the analysis:

- RISE participants contributed to the initial and closing workshops, either by providing input to the process or participating directly in the workshops. Their expertise helped connect the findings to Swedish research, innovation, testbed, resilience and implementation capabilities.
- Participants from Umeå contributed to the City Workshop, providing perspectives on municipal transformation, citizen-centred development and the potential for city-to-city collaboration between Sweden and Ukraine.
- Participants from Superhumans contributed to the Innovation Workshop, providing practical experience of how innovation can be organised around urgent human needs and how rehabilitation can develop into a broader innovation ecosystem.

- Valeriya Ione guided an innovation network session, contributing a Ukrainian innovation-system perspective and helping explore how networks of public, private, research and entrepreneurial actors can support future-oriented innovation.

## 0.9.1. Overall strategic perspectives

**Anders Wijkman, Viable Cities**

Relevant to the report through his long-standing work on sustainability, systems transformation and the role of cities in accelerating societal transitions. His perspective is particularly relevant to the report's argument that reconstruction should not simply restore previous systems, but should create more resilient, sustainable and human-centred systems. This connects directly with the report's treatment of municipalities as living laboratories for transformation.

**Margot Wallström, independent expert**

Contributed a broad international and strategic perspective. Her experience in European and international affairs is particularly relevant to the report's positioning of Ukraine not simply as a recipient of reconstruction assistance, but as a strategic European partner whose experience can contribute to future approaches to resilience, innovation and societal transformation. She also contributed to the development of the key report.

**Valeriya Ionen, Ukrainian innovation expert**

Relevant through her key role in Ukraine's governmental innovation ecosystem and her knowledge of how Ukraine is developing new approaches to innovation under wartime and reconstruction conditions. Her contribution connects particularly to the report's analysis of WINWIN, mission-oriented innovation, innovation ecosystems and the need to connect government, business, research, start-ups and international partners. Valeriya also guided an innovation network session, helping explore how a future innovation ecosystem and collaborative network could be organised.

**Svitlana Romanko, international energy transformation expert**

Contributed an international perspective on energy transformation and its relationship to resilience, reconstruction and sustainability. Her expertise is directly relevant to one of the report's central arguments: that energy should be understood not simply in terms of infrastructure and energy supply, but as an enabling system for healthcare, housing, water, communications, municipal services and people's everyday lives. The report explicitly proposes moving from infrastructure performance toward service continuity and societal resilience.

## 0.9.2. Cities and municipalities

The City Workshop explored how cities can become platforms for reconstruction, experimentation and human-needs-driven innovation. This is central to the report, which argues that municipalities should increasingly function as living laboratories where energy, housing, mobility, digitalisation, healthcare and other systems can be integrated around societal outcomes. The report specifically identifies the Kherson-Umeå relationship as an opportunity to combine Ukrainian experience of resilience and reconstruction with Umeå's experience of wellbeing and citizen-centred urban development.

**Pourya Salheri, Head of Research, ICLEI**
Provided a global cities perspective. His relevance lies in connecting the Ukraine-Sweden discussion with international experience of urban sustainability, climate action and city transformation. This helps position Ukrainian reconstruction not as an isolated national challenge, but as an opportunity to develop urban solutions with global relevance.

**Vanessa Ware, Ignite Sweden, public-sector innovation**
Relevant to the question of how municipalities and other public organisations can work more effectively with start-ups and emerging technologies. Her perspective contributes to the report's interest in moving beyond conventional procurement and project models toward innovation ecosystems where public needs can generate demand for new solutions.

**Camilla Jägerving Isaksson, Development Strategist, Umeå**
Participated in the City Workshop. Her relevance lies in bringing practical municipal experience from Umeå into the discussion about human-centred urban transformation. Umeå is particularly relevant because of its partnership with Kherson and its experience in sustainability, welfare, citizen-centred planning and long-term urban development. The report identifies Swedish cities such as Umeå as potential contributors of experience in urban systems, sustainability, welfare, mobility and citizen-centred planning.

**Anna Sandström Emmelin, Development Strategist, Umeå**
Participated in the City Workshop. Contributed a municipal development perspective to the exploration of how the Kherson-Umeå partnership could move from general cooperation toward practical innovation around resilience, wellbeing, demographic change and reconstruction. This is closely aligned with the report's proposition that city partnerships can become platforms for mutual learning rather than one-directional knowledge transfer.

**Linn Alexandersson, student, Umeå**
Participated in the City Workshop. Brought a next-generation perspective to discussions about what future cities should deliver for their inhabitants. This perspective is relevant to the report's shift from infrastructure-centred reconstruction toward cities designed around quality of life, participation, accessibility and opportunities for self-realisation.

**Ragna Sjölander, student, Umeå**
Participated in the City Workshop. Contributed a younger-generation and citizen perspective to the exploration of future urban environments. Her participation helped broaden the discussion beyond institutional and technical actors toward the people who will ultimately live in and shape future cities.

**Peter Ekström, Head of Program Support Unit, Department of Innovation and Transformation, Helsingborg**
Relevant because Helsingborg represents one of Sweden's leading municipal environments for public-sector and urban innovation. His experience provides practical insight into how cities can organise experimentation, innovation programmes and cross-sector collaboration. The report specifically highlights the Vinnytsia-Helsingborg relationship as an opportunity to combine Ukrainian digital transformation and urban governance with Swedish smart-city and innovation experience.

**Tetiana Banshchykova, Head of the Department of International and Municipal Cooperation, Kherson**
Contributed the perspective of a municipality facing the immediate realities of war, infrastructure damage and reconstruction. Her relevance is particularly strong for understanding how international city partnerships can respond to concrete local needs while simultaneously building longer-term institutional capacity and international collaboration.

**Oleksandr Tolokonnikov, Deputy Head of the Kherson Regional State Administration for Digital Development, Digital Transformation and Digitalization**
Relevant to the intersection between reconstruction, regional governance and digital transformation. His perspective helps connect the report's analysis of Ukraine's exceptional digital capabilities with the practical challenge of rebuilding and maintaining regional and municipal services under extreme conditions.

**Oleksandr Lemeshchuk, Vice-Rector for Digitalization, Innovation, Investment, Research and Education, Kherson State University**
Contributed the university and research-system perspective from Kherson. His role is particularly relevant to the report's argument that successful reconstruction requires not only infrastructure investment but also local knowledge institutions, research capacity, education, innovation and long-term capability building.

**Göran Henriks, Director of Development, Region Jönköpings län**
Relevant through extensive experience of healthcare development, quality improvement and systems innovation. His perspective helps connect the report's human-needs-driven innovation framework with practical approaches to improving health and public services. This is especially relevant because the report identifies healthcare as a priority environment for developing and testing resilient systems, where continuity of services provides a concrete measure of whether innovation actually improves people's lives.

## 0.9.3. Supporting infrastructure and enabling systems

These participants contributed perspectives on the institutional, financial, healthcare and sustainability infrastructure required to move promising innovations from experimentation toward implementation and scale.

**Alex Yatsiuk, Lead ESG Expert, Green Transition Office**
Relevant to connecting Ukrainian reconstruction and innovation with green-transition objectives, sustainability standards and investment frameworks. His perspective helps bridge the report's focus on immediate resilience with the longer-term requirement that reconstruction also contribute to climate neutrality, sustainable infrastructure and European integration.

**Mikaela Annerling, Regional Director, Swecare**
Relevant to the development of healthcare and life-science collaboration between Sweden and Ukraine. Her perspective helps connect Swedish healthcare innovation capabilities with

Ukraine's urgent and rapidly evolving needs in rehabilitation, resilient healthcare infrastructure and health-system transformation. This aligns with the report's identification of healthcare as one of the strongest areas for practical Sweden-Ukraine innovation collaboration.

**Felicity Spors, EBRD**
Contributed the perspective of an international financial institution and the requirements for financing, implementation and scaling. Her relevance lies in connecting innovation ambitions with the investment structures needed for reconstruction, green transition, infrastructure modernisation and private-sector development. This is important because the report argues that future programmes need to combine research and demonstration with implementation, financing and policy learning.

### 0.9.4. Next generation of innovation: Superhumans

The Superhumans representatives participated in the Innovation Workshop. Their contribution was particularly important because Superhumans represents one of the report's clearest examples of a new generation of human-needs-driven innovation. The report interprets Superhumans as more than a rehabilitation centre. It represents an emerging innovation ecosystem connecting healthcare, technology, architecture, education, employment and social reintegration around restoring human capabilities.

**Olga Rudneva, CEO, Superhumans**
Participated in the Innovation Workshop. Her relevance lies in leading one of Ukraine's most important examples of human-centred innovation under extreme conditions. Superhumans demonstrates how urgent wartime needs can generate new institutional models that combine medical care, advanced technology, rehabilitation, psychological support, social participation and reintegration. Her perspective contributed directly to the report's exploration of innovation organised around restoring and expanding human capabilities.

**Andrey Stavnitser, Founder, Superhumans**
Participated in the Innovation Workshop. His relevance lies in the entrepreneurial and mission-driven logic behind Superhumans and in demonstrating how new institutions can be created rapidly around clearly defined human needs. This provides an important practical example for the report's broader argument that Ukraine's wartime innovation culture can generate models relevant far beyond Ukraine.

**Kateryna Hostiunina, Chief Operating Officer, Superhumans**
Participated in the Innovation Workshop. Her relevance lies in translating the Superhumans vision into operational systems and services. This implementation perspective is important for understanding how ambitious human-centred concepts can move from vision to functioning organisations, and ultimately how similar approaches might be replicated and scaled across Ukraine.

Together, the Superhumans participants helped ground the report's concept of human-needs-driven innovation in a functioning Ukrainian example where success is assessed through restored capabilities, participation, wellbeing and quality of life rather than through technological innovation alone.

## 0.9.5. RISE: research, innovation, resilience and implementation capacity

Participants from RISE were involved in the **initial and closing workshops**, either by providing input to the process or participating directly in the workshops. Their collective role was to bring perspectives from different parts of RISE's research and innovation capabilities and to help assess how Swedish expertise could connect with the opportunities identified in Ukraine.

This is particularly relevant because the report sees RISE and Swedish universities as potential partners for research, testing and evaluation within future Ukraine-Sweden innovation initiatives.

**Carl Heath, Digital Resilience**
Contributed expertise related to digital resilience, societal preparedness and the ability of digital systems and institutions to continue functioning under disruption. This connects directly with the report's analysis of Ukraine's digital transformation and the growing importance of cybersecurity, digital public infrastructure and resilient digital-physical systems.

**Gustav Fridlund, Innovation and Process Lead for Local and Regional Transition**
Contributed expertise in local and regional transformation processes. His relevance is particularly strong for the report's focus on municipalities as living laboratories and on creating innovation processes that connect local needs, research, companies and public-sector actors.

**Sofia Måberg, Project Leader, Testbeds**
Contributed a testbed and experimentation perspective. This is directly relevant to the report's proposal that reconstruction projects should function as living laboratories where new solutions can be demonstrated, evaluated and improved in real-world environments rather than remaining conventional infrastructure projects.

**Adam Edström, Focus Area Lead for "RISE in Digital Europe", Testbeds**
Contributed perspectives on digital innovation, European collaboration and testbed infrastructure. His relevance lies in connecting Ukrainian experimentation with European research and innovation structures and in considering how digital technologies can be tested and scaled across countries and institutional contexts.

**Johan Rosell, Head of Total Defence**
Contributed a total-defence and societal-resilience perspective. His expertise is particularly relevant to the report's discussion of critical infrastructure, energy resilience, continuity of essential services and the lessons that Sweden and other European countries can learn from Ukraine's experience of maintaining societal functions under severe disruption.

**Andreas Johansson, Business Development**
Contributed an implementation and business-development perspective. His relevance lies in considering how research findings and promising innovations can develop into partnerships, projects, demonstrations and scalable solutions involving RISE, Ukrainian actors, Swedish companies, municipalities and funding organisations.

Taken together, the RISE participants helped connect the report's strategic findings with potential Swedish research and innovation capabilities. This is important because the report argues that the strongest future collaboration should not be understood as one-way knowledge transfer from Sweden to Ukraine. Instead, Sweden contributes capabilities in systems integration, long-term planning and sustainability, while Ukraine contributes rapid deployment, adaptive governance, resilience and real-world experimentation. The opportunity is therefore one of mutual learning and joint innovation.

# A: Ukraine’s innovation ecosystem: Focus and priorities

# 1. Ukraine’s Innovation ecosystem

**Summary**
Chapter 1 examines Ukraine's innovation ecosystem and WINWIN 2030 from a systems perspective. It looks beyond visible activity, such as start-ups, digital government and wartime technologies, to assess the patterns, structures, assumptions and purposes shaping the system. Its scope includes WINWIN, its 14-sector framework and 29 reports, asking whether innovation is organised not only for growth, security and competitiveness, but also to improve people's lives.

The principal finding is that Ukraine combines strong human capital, rapid crisis-driven innovation and a dynamic ecosystem with weak commercialisation, R&D underinvestment, brain drain, institutional fragmentation, external capital and market dependence, and poor translation of technical capacity into lived outcomes.

WINWIN is more structurally developed and socially ambitious than much of the literature: it connects innovation with recovery, security, digital transformation, inclusion, living standards and self-realisation. Yet its operational logic centres on technologies, sectors, exports and competitiveness. The literature is likewise strong on events and structures but weak on assumptions and purpose. It does not assess dual-use innovation across structures, mental models and purpose, or explain how war-driven innovation could be converted into peace systems. The chapter therefore identifies a needed shift towards innovation for human needs and flourishing lives within planetary boundaries.

**Conclusions for Energy Innovation**
For energy innovation, the chapter identifies energy as a potential bridge across this gap because it connects technology and economic development to health, housing, affordability, food systems, public services and wartime resilience.

**Recommendations**
1. Shift from energy supply to energy services for life.
2. Embed decentralised and resilient energy systems in reconstruction.
3. Link energy innovation to comfort, affordability, reduced energy poverty, healthier indoor environments and wellbeing.
4. Use Ukraine’s extreme conditions to test war-resilient distributed energy and AI-energy-security integration.
5. Reorient innovation more broadly towards human needs and flourishing lives within planetary boundaries.

**Chapter Structure**
The chapter is structured in four parts. Section 1.1 introduces the five-level iceberg model: events, patterns, structures, mental models and purpose. Section 1.2 applies this framework to WINWIN. Section 1.3 examines how the strategy is translated into sector priorities, focusing especially on energy. Section 1.4 uses the same model to synthesise the wider literature and compare its conclusions with WINWIN and the sector framework.

## 1.1. Review method

Innovation strategies often operate on multiple levels at once:

- They describe what is happening (e.g., war-driven innovation),
- They identify trends and challenges (e.g., talent loss, weak commercialisation),
- They propose system reforms (e.g., funding, regulation, sector priorities),
- And they reflect underlying assumptions about what innovation is for.

Focusing only on the visible elements, such as priority sectors, funding programs, or startup activity, risks missing deeper questions, such as:

- What kind of society is the innovation system designed to create?
- How are the systems affecting delivery on human needs affected (energy, health, housing, mobility) affected?
- Does innovation primarily serve competitiveness, or does it systematically improve people's lives?

To address these questions, this chapter applies the full iceberg model, a well-established framework from systems thinking.

### 1.1.1. A full iceberg model

Applying the full iceberg model to assessments of Ukraine's innovation system allows for an expansion beyond surface-level narratives such as "Ukraine is innovating despite war", "Startups are resilient", "Digital government is advancing rapidly".

These statements are true, but incomplete. By analysing the system across all five levels, it is possible to:

1. **Distinguish symptoms from causes**
   War-driven innovation, for example, is an event. But it is shaped by deeper structures (military-industrial collaboration), patterns (long-standing engineering strengths), and mental models (innovation as a tool for survival rather than wellbeing).

2. **Understand systemic constraints and opportunities**
   Persistent gaps, such as strong human capital but weak commercialisation, cannot be explained at the event level. They emerge from structural fragmentation, institutional incentives, and historical development paths.

3. **Reveal hidden assumptions**
   Most current analyses implicitly assume that:
   - innovation equals economic growth
   - success equals EU convergence
   - startups are the main drivers of innovation.
   These mental models shape policy and investment decisions, often without being critically examined.

4. **Identify transformation pathways**
   Most importantly, the iceberg model helps identify where leverage for change lies.

While events attract attention, the most powerful interventions occur at deeper levels, by redesigning systems, challenging assumptions, and redefining purpose.

**The Iceberg Model: A Framework for Understanding Innovation Systems**

The iceberg model helps distinguish between different layers of reality in complex systems. What we see on the surface is only a small part of what shapes outcomes. Beneath the surface lie deeper structures, assumptions, and purposes that ultimately determine how a system behaves.

The model is structured into five levels:

1. Events – What is happening right now

These are the visible and immediate developments:

- war-driven innovation (e.g., drones, cybersecurity),
- rapid digitalisation,
- infrastructure destruction and rebuilding.

This level attracts the most attention but often leads to short-term, reactive responses.

2. Patterns – What keeps happening over time

Patterns emerge when we observe events over longer periods:

- recurring talent outflows,
- persistent gaps between research and commercialisation,
- cycles of reform and stagnation.

This level helps move from isolated observations to understanding trends and dynamics.

3. Structures – What is causing these patterns

Structures include the systems and mechanisms that shape outcomes:

- governance systems,
- funding models,
- education and research institutions,
- market structures and regulatory frameworks.

Changing outcomes at scale requires engaging at this level, as structures determine how innovation actually functions.

4. Mental Models – What assumptions shape the system

Mental models are the underlying beliefs and paradigms that guide decision-making:

- Is innovation primarily about economic growth?
- Are startups the main drivers of change?
- Is success defined as EU convergence and global competitiveness?

These assumptions are often implicit but strongly influence what is prioritised and what is ignored.

5. Stance (Purpose) – What the system is ultimately for

At the deepest level lies the purpose of the system:

- Is innovation meant to rebuild the economy?
- Strengthen national security?
- Improve quality of life?
- Enable flourishing lives within planetary boundaries?

This level determines the direction of transformation and what success ultimately means.

Ukraine's current context makes this deeper analysis particularly important. The country is not only rebuilding infrastructure but also reconfiguring its innovation system under extreme conditions.

At the surface, this is visible as rapid innovation in areas such as drones, AI, and logistics. But beneath the surface lies a more fundamental question: What should Ukraine's innovation system ultimately deliver? Most existing reports implicitly answer: economic recovery, productivity growth, and/or integration into the European Union. These are important goals. But they do not fully capture the transformative potential of the current moment.

This chapter therefore uses the iceberg model not only to analyse what is happening, but to highlight a critical gap in leading assessments:

- a lack of focus on how innovation can deliver better lives for people
- and how war-driven innovation can be transformed into systems that support flourishing lives on a flourishing planet

### 1.1.2. Full iceberg model's relevance for Ukraine's innovation ecosystem

The following sections apply the iceberg model to assess the Ukraine's Global Innovation Strategy 2030 (WINWIN)[1]. The iceberg model includes the following five levels that help to understand where different stakeholder focusses their innovation:

**Events**: What is visible and happening now
**Patterns**: What trends are emerging over time
**Structures**: What systems are producing these outcomes
**Mental Models**: What assumptions are actions based on and shape the system
**Purpose**: What the system is ultimately designed to achieve

By moving systematically through these layers, the chapter reveals not only what is known about Ukraine's innovation system, but also what is missing, and where the greatest opportunities for transformation lie. The aim is not only to understand what the strategy proposes and how it is structured, but also, to explore: what it prioritises in practice, what assumptions it builds on, and what kind of future it is likely to deliver.

A central focus of the analysis is the relationship between the strategy's explicit ambition to improve living standards, and its operational focus on technology, sectors, and competitiveness.

Applying the iceberg model to assessments of Ukraine's innovation system allows for an expansion beyond surface-level narratives such as:

- "Ukraine is innovating despite war"
- "Startups are resilient"
- "Digital government is advancing rapidly"

1 Ministry of Digital Transformation of Ukraine. (2024). *WINWIN: Ukraine's global innovation strategy*. https://winwin.gov.ua/assets/files/WINWIN_Main%20Presentation.pdf

These statements are true, but incomplete. By analysing the system across all five levels, it is possible to:

1. **Distinguish symptoms from causes**
   War-driven innovation, for example, is an event. But it is shaped by deeper structures (military-industrial collaboration), patterns (long-standing engineering strengths), and mental models (innovation as a tool for survival rather than wellbeing).

2. **Understand systemic constraints and opportunities**
   Persistent gaps, such as strong human capital but weak commercialisation, cannot be explained at the event level. They emerge from structural fragmentation, institutional incentives, and historical development paths.

3. **Reveal hidden assumptions**
   Most current analyses implicitly assume that:
   - innovation equals economic growth
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   - startups are the main drivers of innovation
   These mental models shape policy and investment decisions, often without being critically examined.

4. **Identify transformation pathways**
   Most importantly, the iceberg model helps identify where leverage for change lies. While events attract attention, the most powerful interventions occur at deeper levels, by redesigning systems, challenging assumptions, and redefining purpose.

This creates a critical question:

> **To what extent is Ukraine's innovation system designed to deliver better lives for people, and where are the opportunities to strengthen this link?**

The analysis highlights an important opportunity. Ukraine has strong human capital, rapid innovation capability under crisis, and a highly dynamic ecosystem of startups, institutions, and international partnerships.

The WINWIN strategy builds on these strengths to create a powerful innovation system. At the same time, there is an opportunity to take a further step: To move from "innovation as a driver of growth and competitiveness" to "innovation as a system for delivering flourishing life-years".

This means focusing on how innovation improves daily life systems (energy, health, mobility, housing, food); ensuring that technological progress translates into tangible wellbeing outcomes; and aligning innovation with both human needs and long-term sustainability.

Throughout the analysis, particular attention is given to the gap between ambition (better lives) and implementation (technology and sectors), vs the opportunities to strengthen the

strategy by integrating a human-needs and flourishing life perspective, including the critical role of sectors such as energy.

## 1.2. WINWIN – Ukraine's Global Innovation Strategy

Ukraine's Global Innovation Strategy 2030 (WIN-WIN) is an ambitious attempt to define how a country under extreme pressure can rebuild, modernise, and position itself as a global innovation leader. Developed in the context of full-scale war and reconstruction, the strategy outlines a vision where innovation drives economic recovery, strengthens national security, accelerates digital transformation, and improves living standards for citizens as well as create new opportunities for self-realisation of citizens.

At its core, the strategy presents Ukraine as a hub for technological development, a driver of innovation in Europe, and a society where innovation creates new opportunities for individuals, businesses, and communities.

Importantly, the strategy explicitly emphasises improving living standards, inclusion, and opportunities for self-realisation as key outcomes of innovation. This signals an ambition that goes beyond purely economic goals. However, as with many national innovation strategies, there is a need to look beyond stated ambitions and examine how the system is designed, what assumptions it builds on, and what it is most likely to deliver in practice.

### 1.2.1. Summary of WINWIN using the full iceberg model

Section 1.3 applies the full iceberg model perspective to a literature review of Ukraine's innovation ecosystem. The results are summarised below.

**Events**

The WINWIN strategy is firmly grounded in the realities of war and recovery: infrastructure destruction, talent loss, reduced R&D capacity, and urgent needs in defence, cybersecurity, health, and reconstruction.

At this level, there is a clear alignment between crisis-driven innovation (defence tech, drones, digital governance), and immediate societal needs (security, survival, functioning institutions). However, "better living standards" is not operationalised at the event level – it appears more as an intended outcome than as a guiding lens for current actions.

**Patterns**

The WINWIN strategy identifies persistent systemic trends:

- strong human capital but weak commercialisation
- underinvestment in R&D
- brain-drain
- fragmented institutions
- dependence on external capital and markets

A critical additional pattern that emerges is that innovation is repeatedly mobilised in response to crisis or competitiveness, not systematically organised around improving everyday life systems (health, housing, mobility, energy, food).

This confirms the literature review insight, that Ukraine has strong technical capacity but weak translation into lived wellbeing outcomes.

**Structures**

The WINWIN strategy has a strong structural basis, including:

- four strategic pillars (human capital, innovation system, financing, sector policy)
- 14 priority tech sectors
- regulatory reforms, IP systems, venture capital, clusters, smart specialisation
- coordination mechanisms across government

The structures are designed to accelerate innovation capacity, increase competitiveness, and enable sector growth. But they are not explicitly designed to optimise delivery of better lives (e.g. health outcomes, energy affordability, mobility access, daily wellbeing).

This creates a structural gap. The system is designed to produce innovation, not necessarily to produce improvements in lived experience.

**Mental Models**

Implicit assumptions in the strategy include:

- innovation = economic growth
- success = EU integration + global competitiveness
- sectors = key vehicles of transformation
- defence innovation = strategic necessity
- digitalisation = efficiency + transparency

At the same time, the strategy explicitly states ambitions around improved living standards, inclusion and equality, support for vulnerable groups, and self-realisation opportunities. This demonstrates a dual mental model:

**Table A1.1: WINWIN dual mental model**

| Layer | Mental model |
|---|---|
| **Explicit narrative** | Innovation should improve lives |
| **Operational logic** | Innovation should drive competitiveness, sectors, exports |

With the result that “better lives” is a declared goal, but “technology + sectors + growth” is what the actual organising logic focuses on.

**Stance (Purpose)**

The strategy’s purpose can be summarised as:

- Build a resilient, innovation-driven Ukraine
- Achieve economic breakthrough and global positioning
- Strengthen security and defence capability
- Improve living standards and inclusion

The strategy does include a strong normative commitment to better lives, but it does not redefine innovation around delivering those lives.

## 1.3. WINWIN – Ukraine's Sector Strategy

Ukraine's sector framework operationalises the WINWIN strategy across 14 technology domains (defence, AI, biotech, govtech, greentech, etc.). The sector framework reinforces the gap identified above, it is strong on technology development, strong on industry-building, but weak on life-system outcomes.

For example, the following technology domain mappings are clear:

- Defence tech → national security
- GovTech → efficiency and digital services
- Greentech → energy transition

But there is limited articulation of how these sectors improve everyday life systems (e.g., affordable energy, healthy homes, resilient communities).

### 1.3.1. Energy sector in WINWIN

While greentech is included, energy is treated mainly in terms of infrastructure, decarbonisation, EU alignment, and technology deployment (AI, smart grids, hydrogen, renewables).

Energy is not currently clearly linked to the core purpose of the Ukrainian innovation strategy, but energy is foundational for health (heating, cooling, hospitals), economic participation, housing quality, resilience during war, cost of living, and urban and rural viability. Ukraine is also investing significantly in digitalisation, which links to smart energy systems where digitalisation is also aligned with Ukrainian priorities.

Therefore, energy is one of the strongest leverage points for delivering on the overall goal to "lead to an increase in living standards and the creation of new opportunities for self-realization of citizens" (Ministry of Digital Transformation of Ukraine, 2024). Energy innovation could become a core integrator across sectors:

**Table A1.2: Energy as an integrator across sectors**

| Sector | Energy connection |
|---|---|
| **Defence tech** | energy resilience, decentralised systems |
| **GovTech** | smart grids, digital energy management |
| **Health (MedTech)** | resilient hospital systems |
| **Agrotech** | energy for food systems |
| **Housing / reconstruction** | energy-efficient buildings |
| **AI** | optimisation of energy demand and systems |
| **Greentech** | renewable production + storage |

### 1.3.2. Opportunities to strengthen energy innovation within WINWIN logic

To align with the WINWIN strategy and extend it, energy innovation could:

**I.** Shift from "energy supply" to "energy services for life"
Examples: thermal comfort, affordability, reliability, and resilience in war conditions.

**II.** Embed energy in reconstruction
Examples: zero-energy housing, district heating redesign, decentralised energy systems for cities and villages

**III.** Link energy to human outcomes
Examples: reduced energy poverty, healthier indoor environments, increased productivity and wellbeing.

**IV.** Support Ukraine as a global testbed
Examples: war-resilient energy systems, distributed energy under extreme conditions, integration of AI + energy + security.

Energy could become a system integrator that supports a shift from sector-based innovation to life-system-based innovation.

## 1.4. Ukraine's Innovation ecosystem – a literature review

This section identifies key documents and their relevance to understanding Ukraine's innovation ecosystem. The documents referenced as "(N)" below can be found in reference appendix R1.

### 1.4.1. From War Economy to System Transformation

Ukraine's current context makes this deeper analysis particularly important. The country is not only rebuilding infrastructure, but also reconfiguring its innovation system under extreme conditions.

At the surface, this is visible as rapid innovation in areas such as drones, AI, and logistics. But beneath the surface lies a more fundamental question: What should Ukraine's innovation system ultimately deliver? Most existing reports implicitly answer: economic recovery, productivity growth, and integration into the European Union. These are important goals, but they do not fully capture the transformative potential of the current moment.

This section therefore uses the iceberg model described in section 1.1 to analyse what is happening, but also to highlight a critical gap in leading assessments: a lack of focus on how innovation can deliver better lives for people and how war-driven innovation can be transformed into systems that support flourishing lives on a flourishing planet

The following sections apply the iceberg model to assess 29 key reports on Ukraine's innovation system (see appendix R1 for descriptions of the reports) based on:

- Events: What is visible and happening now
- Patterns: What trends are emerging over time
- Structures: What systems are producing these outcomes
- Mental Models: What assumptions shape the system
- Stance: What the system is ultimately designed to achieve

This reveals not only what is known about Ukraine's innovation system, but also what is missing, and where the greatest opportunities for transformation lie.

**Table A1.3: Literature review using the full iceberg model**

| Iceberg level | Reports primarily operating | What the reports focus on/ identify/ analyse/ assume | Typical framing | Insights |
|---|---|---|---|---|
| **Events** | Startup Genome (9, 10)<br>The Recursive (11)<br>UNICEF (26)<br>UNESCO (27)<br>WEF (29) | War-driven innovation (drones, AI, logistics).<br>Startup resilience during war.<br>Rapid digital government deployment (Diia).<br>Infrastructure destruction & rebuilding.<br>Emergency education responses.<br>Surge in defence-tech startups. | "Ukraine is innovating despite war".<br>"Startups are adapting quickly".<br>"Digital government is functioning". | This level is well covered, but:<br><br>It is reactive and descriptive, not explanatory<br>It risks overestimating resilience without understanding sustainability<br>Often ignore more human challenges such as cities becoming smaller and with an aging population. |
| **Patterns** | WIPO (17–19)<br>OECD Economic Survey (3)<br>EBRD (20, 21)<br>ETF (23, 24)<br>World Bank (12) | Strong IT and engineering base (pre-war → war → ongoing).<br>Repeated reform cycles (slow progress, then acceleration under crisis).<br>Persistent gap between innovation potential and commercialisation.<br>Dependence on external markets and capital<br>Brain-drain vs diaspora engagement. | "Ukraine has high human capital but low innovation output"<br>"Reforms are progressing but uneven"<br>"Digital sector outperforms traditional sectors" | This level is moderately strong, but:<br><br>Patterns are often described, not explained systemically.<br>Limited connection between patterns (e.g., education ↔ startups ↔ governance). |
| **Structures** | World Bank (12–15)<br>OECD (1, 2)<br>EU Ukraine Report (7, 8)<br>EBRD (22) | Weak commercialisation systems (IP, tech transfer).<br>Fragmented research system.<br>Limited venture capital ecosystem.<br>Regulatory barriers.<br>Public procurement systems (Prozorro as positive case).<br>Education–industry disconnect. | "Institutions need reform"<br>"Better incentives are required"<br>"Systems are fragmented" | This is the strongest level in the literature, but:<br><br>Structures are treated as technical problems, not political or strategic systems.<br>Focus is on fixing components, not redesigning the system. |
| **Mental models** | OECD (1) → hints at transformation<br>World Bank (16) → productivity narrative | Innovation = economic growth.<br>Success = convergence with EU.<br>Startups = primary innovation vehicle.<br>War innovation = temporary necessity. | Most reports operate with unquestioned 20th-century innovation logic. | This level is weakly addressed. Missing:<br><br>Innovation as a system for human needs / wellbeing.<br>Dual-use innovation as a core paradigm.<br>Innovation beyond GDP. |

| | | | | |
|---|---|---|---|---|
| | UNDP (25) → impact investing (slight shift) | Civilian and military innovation = separate domains.<br>Human wellbeing = indirect outcome (not goal). | | Systemic redesign vs incremental reform. |
| **Stance/ Purpose** | None with a focus on transformative potential. | Rebuilding the economy.<br>Integrating into the EU.<br>Increasing productivity.<br>Strengthening competitiveness. | As above. | This level is very weakly addressed. Missing:<br><br>Delivering flourishing lives.<br>Aligning with planetary boundaries.<br>Using innovation to transform everyday life systems.<br>Converting war-driven innovation into peace systems. |

### 1.4.2. Overview of literature review

The following table summarises the findings of the literature review using the full iceberg model.

**Table A1.4: Literature review full iceberg model gaps**

| Level | Strength in literature | What is covered | What is missing |
|---|---|---|---|
| **Events** | Strong | War innovation, startups, digital gov | Long-term meaning |
| **Patterns** | Medium | Trends, performance gaps | System connections |
| **Structures** | Strong | Policy, institutions, funding | System redesign |
| **Mental models** | Weak | Mostly implicit | Critical reflection |
| **Stance** | Very weak | Growth & EU alignment | Delivery on human needs and a postive vision for the future |

A key insight is that the literature is top-heavy (strong on events and structures) and bottom-blind (weak on mental models and purpose). This creates a fundamental problem, the current analyses answers: How does Ukraine innovate? and: What structures need fixing? But it fails to answer: 'What should innovation actually deliver?' and 'How does the current war driven innovation ecosystem contribute in the long-term to becoming providers of flourishing lives on a flourishing planet, including energy innovations that both deliver flourishing lives for all and are globally sustainable?'.

Dual-use innovations are not assessed in relation to structures, mental modules, and stance, e.g. drones are discussed as tools, not as system transition mechanisms. This is a major analytical shortcoming as no connection between innovation and lived experience are established, e.g. health, mobility, food, wellbeing are largely absent.

Innovation is treated as an abstract economy, not daily life, hence there is little system-level transformation logic as reports focus on reform and improvement in existing systems not transformation and redesign.

What is needed is a mental model shift that moves from: innovation as growth to innovation as delivering human needs. Then also a stance shift that moves from rebuilding of the economy to redesign of systems for flourishing lives.

**Table A1.4: Comparative summary WINWIN strategy, sector framework, and literature**

| Iceberg level | WINWIN strategy | Sector framework | Literature review | Key insight |
|---|---|---|---|---|
| **Events** | Strong (war, reconstruction, tech response) | Very strong (sector-specific urgency) | Strong | Alignment across all |
| **Patterns** | Moderate–strong (brain drain, weak commercialisation) | Strong (repeated bottlenecks) | Medium | Strategy more operational |
| **Structures** | Very strong (systems, policy, sectors) | Very strong (sector missions, tools) | Strong | Strategy ahead of literature |
| **Mental models** | Explicit goal: better living standards BUT implicit logic: competitiveness + sectors | Similar (tech-driven transformation) | Weak but critically examined | Tension between stated purpose and operational logic can be a driver for a new generation of innovation and collaboration |
| **Stance (purpose)** | Includes strong ambition for better lives and inclusion | Sector-focused national advantage | Very weak | Opportunity: Explore how flourishing life-years can sharpen innovation in line with the explicit goal of “better living standards” |

The WINWIN strategy is stronger than most of the reviewed literature. It is structurally advanced, it includes social ambitions (better living standards, inclusion), and it recognises systemic challenges.

Ukraine is uniquely positioned to move from innovation for competitiveness to innovation for better lives. Energy is a strong entry point for this because it cuts across all sectors, directly affects daily life, is central to reconstruction, and has global relevance.

The WINWIN strategy provides a strong structural foundation and a clear ambition for better lives but currently is not supported in a systematic translation of that ambition into how innovation is organised to deliver better lives for people.

# 2. Ukraine’s Innovation capacity and needs

**Summary**
Chapter 2 assesses Ukraine's innovation capacity and what is needed to turn it into implementation and long-term impact. It maps government, municipalities, cities, universities and research organisations, private firms, investors, innovation platforms and the Ukrainian diaspora, then synthesises the findings through a SWOT. The central question is not only whether Ukraine can generate ideas and technologies, but whether it can coordinate, commercialise and apply them to reconstruction, essential services and better daily life.

Ukraine's strengths include adaptive innovation under wartime pressure, engineering and digital talent, platforms such as Diia and Brave1, international integration and private-sector delivery. It also offers globally relevant real-world environments for testing resilience under attack, although demonstrated experience must be distinguished from pilots and prospective scaling. Rehabilitation ecosystems such as Superhumans show another capacity: integrating technology, healthcare, psychological support, employment and social reintegration around restored capability, dignity and participation. Capacity is geographically distributed, with Kyiv and seven other mapped cities offering complementary strengths.

The main weaknesses are fragmentation, weak commercialisation and scaling, uneven municipal capacity, talent loss, damaged research infrastructure and a gap between technology and better living conditions. The diaspora should be treated not only as brain drain, but as a source of brain circulation, international links, investment and reconstruction capacity. Threats beyond brain drain include the continuing war, fragmented international support, reconstruction lock-in, and institutional weakening, corruption and procurement risks, uneven coordination and unclear ownership of cross-sector missions, cyber-physical dependencies, and an over-focus on competitiveness instead of wellbeing.

The chapter concludes that technical excellence and infrastructure are insufficient without clear value propositions, organisational maturity, commercialisation support, market knowledge, international networks and intermediaries connecting research with users, industry and partners.

**Conclusions for Energy Innovation**
Energy is strategic but responsibility is divided among ministries, reconstruction bodies, municipalities, firms and research institutions. Technical progress is relatively strong, but energy innovation remains weakly integrated with lived outcomes and is not consistently assessed against affordability, thermal comfort, public health, service continuity and local resilience. The chapter proposes treating energy as a life-support system and system integrator rather than only as infrastructure, supply, security or market design.

Promising directions include long-term missions for energy-positive reconstruction and resilient municipal systems; civilian use of wartime capabilities in microgrids and infrastructure protection; water-energy resilience; and district heating and thermal resilience as a potential bilateral flagship. Municipalities should co-design innovation

because they manage buildings, heating, utilities and essential services. Cybersecurity and resilience should be built into digital and distributed energy systems.

**Conclusions for Sweden-Ukraine Cooperation**
Cooperation should combine complementary capabilities rather than follow a one-way donor-recipient model. Sweden contributes district-heating, heat-pump, storage, systems-integration, municipal-planning and innovation-governance expertise. Ukraine contributes engineering talent, rapid deployment, reconstruction environments and operational learning under disruption. Joint work could generate knowledge for both countries and European resilience.

Opportunities include resilient-energy and district-heating missions, municipal living labs, joint calls, private-sector pilots, multilateral programmes using EU finance, and stronger links among firms, RISE, universities, municipalities, agencies, testbeds and investors. Ukrainian researchers, entrepreneurs and professionals in Sweden should be included deliberately.

**Recommendations**

1. Establish 10- to 15-year mission portfolios combining research, innovation, deployment and infrastructure.
2. Redefine success to include healthy lives, comfortable homes, affordable energy and resilient essential services alongside technology, GDP, start-ups and exports.
3. Build multilateral mission coalitions sharing funding, governance, standards, testbeds and evidence.
4. Strengthen municipal innovation capacity and create distributed living labs where security, capacity and partner readiness allow.
5. Build diaspora innovation and brain-circulation channels through dual affiliations, joint projects, mentorship and investment networks. A concrete next step could be to develop a Sweden-Ukraine Diaspora Innovation Track for mapping relevant people, mobilising them through programmes and partnerships, and accelerating diaspora-enabled projects.
6. Structure Sweden-Ukraine collaboration as mutual learning, especially in resilient energy, district heating, municipal systems, healthcare and human-centred reconstruction.
7. Consider creating a dedicated bilateral private-sector track linking Ukrainian firms and clusters to Swedish institutes, companies, municipalities, testbeds, investors and innovation agencies.

**Chapter Structure**
Section 2.1 maps government stakeholders and trends.
Section 2.2 compares eight city ecosystems.
Section 2.3 examines private-sector capacity and cooperation with Sweden.
Section 2.4 analyses the diaspora and its academic, entrepreneurial and Swedish dimensions.
Section 2.5 presents the SWOT analysis and six strategic priorities.
Section 2.6 explains the organisational and intermediary capabilities needed to turn capacity into lasting impact.

## 2.1. Government stakeholders

Below is a mapping of the government actors in Ukraine's innovation ecosystem, with attention given to both their traditional innovation roles and their relevance for human-needs-driven innovation, especially in energy.

The following table summarises the more detailed descriptions that follow and this section ends with an analysis of trends.

**Table A2.1: Government innovation overview**

| Actor | Core mandate | Role in innovation ecosystem | Capacity (strengths & constraints) | Key relationships | Role in traditional energy innovation | Role in human-needs-driven energy innovation |
|---|---|---|---|---|---|---|
| **Ministry of Digital Trans-formation** | Digital state, digital economy, GovTech, Diia ecosystem | Builds digital infrastructure layer: platforms, services, digital business environment | High capacity: agile, politically supported, strong execution track record (Diia). Constraint: focus on digital layer rather than sector outcomes | Cabinet, Economy, Education, municipalities, private tech sector | Enables smart grids, data systems, cybersecurity, digital energy services | Strong potential to enable citizen-facing energy services, but not yet fully oriented toward wellbeing outcomes (e.g., affordability, comfort) |
| **Ministry of Economy** | Industrial policy, SME development, investment, recovery economics | Shapes market conditions: funding, incentives, commercialisation, scaling | Medium–high capacity: strong policy tools and donor alignment. Constraint: fragmentation, broad mandate, implementation complexity | Digital, Education, Cabinet, donors, private sector | Drives energy transition as economic opportunity (green industry, investment frameworks) | Potential to connect energy to jobs, affordability, reconstruction, but currently biased toward competitiveness and export logic |
| **Ministry of Education and Science** | Universities, research, human capital, science policy | Provides talent and knowledge base: upstream innovation capacity | Medium capacity: strong human capital base, but underfunded and structurally fragmented; weak commercialisation | Economy, Digital, research institutes, international academia | Develops engineering, energy expertise, research capacity | High potential to support systemic, interdisciplinary solutions (energy + health + housing), but currently underutilised |
| **Ministry of Defence and formerly Ministry of Strategic Industries** | Defence industry, dual-use innovation, military capability | Drives mission-oriented innovation: defence-tech ecosystem, scaling, procurement | High capacity (in wartime domains): strong urgency, coordination (e.g. Brave1). Constraint: focus on military priorities | Startups, Digital, Economy, international partners | Focus on energy resilience, battlefield energy systems, infrastructure protection | Strong spillover potential (microgrids, resilience tech), but requires deliberate civilian integration |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cabinet of Ministers** | National coordination, strategy approval, cross-sector governance | Coordinates whole innovation system, aligns ministries and national priorities | High formal capacity, but variable execution capacity due to complexity and fragmentation | All ministries, Parliament, international partners | Aligns cross-sector energy policy (economy, energy, reconstruction) | Only actor with capacity to align energy + housing + social systems, but requires stronger outcome-oriented coordination |
| **Verkhovna Rada - Parliament** | Lawmaking, regulation, budget, EU alignment | Defines legal framework for innovation and markets | Medium capacity: strong legislative power, but dependent on political alignment and speed | Ministries, committees, EU frameworks | Defines energy market rules, infrastructure laws, incentives | Critical for consumer protection, affordability, housing standards, but indirect influence on innovation outcomes |
| **Regional & Municipal Govern-ments** | Local development, infrastructure, services, reconstruction | Translate innovation into real-world implementation | Highly variable capacity: strong local knowledge, but uneven resources, skills, and autonomy | Ministries, local businesses, universities, NGOs, donors | Manage district heating, buildings, local infrastructure, reconstruction | Very high relevance but underutilised capacity: closest to real needs, but weak integration into innovation design |
| **Ministry of Energy** | Energy policy, generation, grids, transition, security | Leads energy sector innovation and infrastructure systems | Medium capacity: strong technical mandate, but constrained by war damage, legacy systems, and coordination gaps | Economy, Cabinet, municipalities, international partners | Core actor for renewables, grid modernisation, energy security | Needs to expand toward energy as a service (comfort, affordability, resilience) rather than only supply/infrastructure |
| **Ministry for Develop-ment of Comm-unities & Territories (+ Resto-ration Agency)** | Reconstruction, housing, infrastructure, regional development | Embeds innovation into physical systems and rebuilding | Medium–high capacity (growing): strong donor support and relevance; constraint: scale and complexity of reconstruction | Municipalities, Energy, Economy, Cabinet, donors | Shapes energy performance of buildings, infrastructure, cities | Critical leverage point: directly impacts living conditions, housing quality, local energy systems |

### 2.1.1. Ministry of Digital Transformation

The Ministry of Digital Transformation is the clearest state actor for building Ukraine's digital innovation layer. It has driven the Diia ecosystem[2], digital public services, digital infrastructure, digital skills, cyber-related initiatives, Diia.Business, and the special legal-tax

2 Digital State UA. (n.d.). *Diia*. https://digitalstate.gov.ua/projects/govtech/diia

framework Diia.City for tech firms. Official ministry materials present it not just as a service digitiser but as a builder of a wider digital economy and innovation ecosystem.[3]

A major influence it has in the innovation ecosystem is on the enabling environment rather than on science itself. It shapes digital public infrastructure, startup and IT business conditions, access to online services for entrepreneurs, data systems and interoperability, the branding of Ukraine as a digital state.[2,3,4]

Its relationship to other actors is central and cross-cutting. It depends on the Cabinet of Ministers and Parliament for laws and approvals, works with the Ministry of Economy where digital business policy overlaps with SME and industrial policy, and interacts with the Ministry of Education and Science on digital skills and talent pipelines. It also touches municipalities through digital public services and local digitalisation, and increasingly intersects with defence-tech through cyber, cloud, and data infrastructure.

For traditional energy innovation, the ministry is not the lead actor, but it influences the digital backbone that modern energy systems need: data, registries, digital identity, cyber resilience, and public-facing service systems. For human-needs-driven energy innovation, its relevance is even more interesting: digital tools can help households access subsidies, manage energy use, navigate rebuilding services, and connect citizens to local energy and housing programs. The risk is that digitalisation gets treated mainly as efficiency, rather than to improve thermal comfort, affordability, and daily resilience.

### 2.1.2. Ministry of Economy

The Ministry of Economy is a central state actor in Ukraine's economic innovation architecture. Its remit spans SME development, industrial policy, business support, investment promotion, parts of recovery policy, and innovation funding/commercialisation. Official materials point to eRobota, "Made in Ukraine," investment and reconstruction initiatives, and the Strategy for the Recovery, Sustainable Development and Digital Transformation of SMEs until 2027. [5]

Its importance lies in shaping how ideas become economic activity: SME growth, industrial upgrading, grants/incentives, investment attraction, market formation, exports, and reconstruction-linked business opportunities. It also connects with Digital Transformation on startups and digital business, Education and Science on skills and R&D relevance, the Cabinet on recovery/regulation, and international partners, since many donor-backed recovery and private-sector programmes run through economic-policy channels.

For energy innovation, the ministry matters because it hosts Ukraine's National Energy and Climate Plan 2025–2030, framing energy transition as economic modernisation as well as

3 Ministry of Digital Transformation of Ukraine. (n.d.). *About us*. https://thedigital.gov.ua/ministry

4 Ministry of Digital Transformation of Ukraine. (2025). *WINWIN: Ukraine approved the Digital Development Innovation Strategy until 2030* [Translated]. https://thedigital.gov.ua/news/technologies/winwin-ukraina-zatverdila-strategiyu-tsifrovogo-rozvitku-innovatsiy-do-2030-roku

5 Ministry of Economy of Ukraine. (2024). *Government approves SME Development Strategy until 2027 and operational action plan for 2024–2027*. Cabinet of Ministers of Ukraine. https://www.kmu.gov.ua/en/news/uriad-skhvalyv-stratehiiu-rozvytku-maloho-ta-serednoho-biznesu-do-2027-roku-ta-operatsiinyi-plan-zakhodiv-na-2024-2027-roky

sector policy. This gives it leverage over incentives, competitiveness, green industry, and market integration.

For human-needs-driven energy innovation, it is potentially pivotal, though not yet fully oriented that way: it could link energy solutions to lower household energy burdens, reconstruction jobs, circular local value chains, housing retrofits, and resilient services. The opportunity is to shift from "energy as industrial opportunity" to "energy as an enabler of better lives," aligning with WINWIN's living-standards ambition but requiring more explicit targeting.

### 2.1.3. Ministry of Education and Science

The Ministry of Education and Science is the anchor institution for universities, research organisations, human capital, and parts of national science policy. Ministry and associated materials emphasise its role in sustainable and innovative development of the education and science system, international scientific cooperation, and the research information architecture, including URIS, the national research information system.[6]

Its primary role in the innovation ecosystem is upstream. It influences the talent pipeline, research capability, university governance, links between science and policy, international research integration, and the institutional basis for future commercialisation.

The ministry's relations are both essential and difficult. It needs the Ministry of Economy and the private sector to make research economically relevant. It needs the Ministry of Digital Transformation to modernise digital education and research systems. It interacts with Parliament on laws and funding, and with international programs such as Horizon Europe and UNESCO-linked science recovery processes. One of the recurring ecosystem problems is that these links have historically been too weak or fragmented.

For traditional energy innovation, this ministry matters through engineering education, materials science, nuclear expertise, power systems research, and training the specialists who can rebuild and modernise the energy sector. For human-needs-driven energy innovation, its importance is broader: it can encourage interdisciplinary work linking energy to health, housing, mobility, social inclusion, and local development. At present, Ukraine's formal innovation discourse still tends to privilege technology and sector performance over these lived-outcome questions, so universities and research institutes could become an important corrective.

### 2.1.4. Ministry of Defence and formerly Ministry of Strategic Industries

The Ministry of Strategic Industries was one of the most important institutions for wartime innovation, industrial capability, and defence-tech scaling. However, the government decided in 2025 to merge it into the Ministry of Defence, explicitly to create a more unified

6 Ministry of Education and Science of Ukraine. (n.d.). *Mission, functions and strategy*. https://mon.gov.ua/en/ministry/about-ministry/mission-functions-and-strategy

framework for defence management and coordination.[7] So, analytically, this role now sits at the junction of industrial policy and defence governance.

This actor's responsibility is concentrated in defence production, dual-use technology, coordination with suppliers and manufacturers, military-industrial capability, scaling of wartime innovation, and links to initiatives such as Brave1[8].

Its relationship to the rest of the ecosystem is unusually intense under war conditions. It works with startups, engineering teams, manufacturers, procurement bodies, the digital ministry, and foreign partners. Brave1 itself is designed as a coordination platform linking government, innovators, financiers, and military users. That makes the defence innovation space one of the most integrated parts of Ukraine's innovation ecosystem.

For traditional energy innovation, this actor is relevant through resilience, backup power, battlefield energy systems, grid security, storage, drones, and industrial capacity for components. For human-needs-driven energy innovation, the connection is through resilience technologies that can later spill over into civilian systems: microgrids, distributed energy, protected infrastructure, and energy systems designed for continuity under attack. Ukraine's challenge is to make sure those spillovers are intentional, not accidental.

### 2.1.5. Cabinet of Ministers of Ukraine

The Cabinet of Ministers is the coordinating centre that turns sectoral agendas into state policy. It approves strategies, action plans, interministerial coordination mechanisms, and the overall recovery-reform direction. The WINWIN strategy itself is presented as a government-adopted national strategy, and the Cabinet has also approved the SME strategy and other cross-cutting reforms.

Its responsibility in the innovation ecosystem is less about direct execution and more about:

- approving national strategies,
- allocating responsibility across ministries,
- resolving overlaps,
- sequencing reforms,
- linking innovation to recovery, EU integration, and fiscal reality.

The Cabinet's relationships are therefore horizontal. It is where the digital ministry, economy ministry, education ministry, defence governance, energy-related actors, and local development actors should in principle come together. In practice, one of Ukraine's long-standing challenges is that this coordination is uneven, which is exactly why strategies repeatedly call for better national-level innovation management.

For traditional energy innovation, the Cabinet matters because energy transition, reconstruction, industry, and infrastructure are cross-sector issues that cannot be solved by one ministry alone. For human-needs-driven energy innovation, its importance is even

7 Ministry of Defence of Ukraine. (2025). *Denys Shmyhal: The Government has merged the Ministry of Strategic Industries into the Ministry of Defence of Ukraine*. https://mod.gov.ua/en/news/denys-shmyhal-the-government-has-merged-the-ministry-of-strategic-industries-into-the-ministry-of-defence-of-ukraine

8 Brave1. (n.d.). *Brave1 defense tech cluster*. https://brave1.gov.ua/en

greater: only the Cabinet can consistently align energy, housing, local government, social policy, reconstruction, and innovation under a shared purpose such as better living standards or flourishing life-years. That alignment opportunity exists, but it is still only partially realised.

### 2.1.6. Verkhovna Rada (Parliament)

The Verkhovna Rada shapes the innovation ecosystem through lawmaking, committee oversight, ratification, taxation, budget laws, and committee-level agenda setting. Relevant committees include Digital Transformation; Education, Science and Innovations; Economic Development; Energy, Housing and Utilities Services; National Security, Defence and Intelligence; and State Building, Local Governance, Regional and Urban Development.

Parliament's role is often underestimated. It determines the legal basis for tax and regulatory incentives, digital economy regimes, support for education and innovation, public procurement rules, energy and housing legislation, alignment with EU law. The 2021 committee action on the law stimulating the digital economy is one concrete example of how parliamentary committees can shape ecosystem conditions.

Parliament also connects Ukraine's innovation governance to EU harmonisation and international commitments, which is especially important in digital regulation, energy market rules, and industrial standards.

For traditional energy innovation, Parliament is indispensable because energy markets, utility systems, building rules, and investment frameworks are legal systems as much as technical systems. For human-needs-driven energy innovation, parliamentary relevance becomes even wider: laws on housing, consumer protection, subsidies, urban services, social protection, and local governance all determine whether energy innovation actually improves daily life.

### 2.1.7. Regional and municipal governments

Regional and municipal governments are the most important public actors for translating national strategy into actual places. They matter because innovation is not only a national policy question; it is also a question of local infrastructure, procurement, reconstruction, skills ecosystems, utilities, transport, and community priorities. Ukraine's governance system increasingly emphasises community development and recovery implementation at local levels.

Their role in the innovation ecosystem includes:

- building local innovation ecosystems,
- working with universities and business locally,
- planning and implementing reconstruction,
- managing public assets and utilities,
- identifying local priorities,
- participating in smart specialisation and donor-funded recovery projects.

Their relationships are highly relational rather than purely hierarchical. Municipalities connect national ministries to communities, firms, utilities, hospitals, schools, and local

construction markets. They can be strong platforms for human-needs-driven innovation because they sit closest to real service systems. But they often face capacity constraints, uneven resources, and dependence on national and international funding.

For traditional energy innovation, local governments matter for district heating, building efficiency, municipal energy systems, local grids, public buildings, and critical infrastructure preparedness. For human-needs-driven energy innovation, they may be the single most important actor because they see the lived impacts of cold homes, damaged infrastructure, unreliable power, and service disruption. If Ukraine wants energy innovation to support better lives, municipalities must become more central to innovation design, not just implementation.

### 2.1.8. Ministry of Energy

Ministry of Energy is too important to omit from any discussion of innovation and not least energy innovation. The broader policy ecosystem around Ukraine's energy transition, resilience, and modernisation references the Energy Strategy to 2050, clean energy expansion, energy system resilience, and energy security as national priorities. Some of that framing appears through investment and policy sources beyond the ministry itself, but it clearly indicates an institutional energy-policy centre.

Its direct role is in:

- electricity and heat system policy,
- generation and grid modernisation,
- security of supply,
- storage and flexibility,
- renewable energy deployment,
- integration with European energy systems.

Its relationship to the innovation ecosystem is often more sectoral than ecosystem-wide. That is why it needs stronger links with the digital ministry, economy ministry, local governments, and reconstruction actors. Without that, energy innovation stays trapped in infrastructure language instead of becoming part of a broader innovation-for-better-lives agenda.

For traditional energy innovation, this is the lead policy actor. For human-needs-driven energy innovation, it should be a co-lead with local government, reconstruction, and social-policy-adjacent institutions. The key shift would be from "more modern energy systems" to "energy systems that deliver warm homes, affordable services, resilient hospitals, functional schools, and viable communities."

### 2.1.9. Ministry for Development of Communities and Territories / restoration system

The Ministry for Development of Communities and Territories and the wider restoration system are essential because reconstruction is where much innovation will actually be embedded. Official materials emphasise recovery priorities, community development, transport, winter preparation, donor coordination, and project pipelines. The State Agency for Restoration is also part of this implementation architecture.

Its innovation relevance sits in:

- rebuilding infrastructure,
- shaping urban and regional systems,
- connecting donor projects to implementation,
- housing and community recovery,
- transport and utility modernisation,
- reconstruction standards and procurement.

Its relationships cut across almost every actor discussed above. It needs the economy ministry for finance and incentives, the energy ministry for infrastructure systems, municipalities for implementation, and the Cabinet for coordination. It is also a natural bridge to international partners and local communities.

For traditional energy innovation, this ministry matters because reconstruction decisions lock in long-term energy performance of buildings, districts, and public infrastructure. For human-needs-driven energy innovation, it may be one of the most important ministries of all, because it can connect innovation to actual living conditions: housing quality, local resilience, access to heat and electricity, public spaces, and community viability.

### 2.1.10. Trends across these government actors

The clearest trend is that Ukraine's innovation governance is becoming more mission-oriented, more integrated with wartime and recovery priorities, and more explicit about innovation as a national development strategy. The WINWIN agenda, Diia ecosystem, SME strategy, defence-tech coordination, and reconstruction architecture all point in that direction.

A second trend is that the ecosystem is increasingly shaped by cross-ministerial overlap. Digital transformation, industrial policy, education, defence, reconstruction, and energy transition now depend on each other much more than before. This is promising, but it also raises the coordination challenge. The system is no longer short of strategic documents; it is short of consistently integrated execution.

A third trend is that energy is moving from a narrow utility issue to a strategic innovation issue, but not yet fully to a human-needs innovation issue. In official discourse, energy is strongly tied to security, decarbonisation, resilience, and European integration. That is important. But the next step is to connect it more directly to better living standards, health, housing, municipal recovery, and daily wellbeing. That is where traditional energy innovation and human-needs-driven innovation can meet.

A fourth trend is that the most advanced public innovation spaces in Ukraine are currently those with a clear user, urgent need, and operational platform. Diia is a strong example in public services, and Brave1 is a strong example in defence-tech. This suggests a broader lesson: sectors move faster when government creates real demand, coordination, and a usable interface for innovators. Energy and reconstruction could benefit from similar platform logic, especially at municipal level.

The final trend is normative. Ukraine's public innovation discourse increasingly says innovation should improve lives, opportunity, and resilience. But the operational machinery still leans more toward competitiveness, security, digitalisation, and sector strength. The biggest opportunity is not abandoning that machinery but redirecting more of it toward flourishing-life outcomes: warm homes, resilient communities, affordable energy, healthy environments, functioning daily services, and strong local futures.

Energy innovation suffers from "distributed responsibility", no single actor has mandate, capacity, and a system-wide perspective. This results in relative strong technical progress, but weak integration into lived outcomes, and human-needs-driven energy innovation sits where capacity is weakest or underused:

- Municipalities – high relevance but uneven capacity
- Reconstruction – growing capacity but overstretched
- Education – high potential but low system integration

## 2.2. Cities

Ukraine's innovation landscape is distributed across multiple urban ecosystems with different specialisations. Rather than a single dominant hub, the country exhibits a networked structure of complementary cities.

Kyiv remains the most comprehensive centre, particularly in digitalisation, entrepreneurship, and system-level innovation. Lviv is a leading hub for startups and IT services. Dnipro and Kharkiv are more closely associated with engineering, industrial modernisation, and technical education. Odesa plays a strategic role in logistics and infrastructure resilience, while Ivano-Frankivsk represent emerging regional innovation centres. Kherson is particularly relevant in the context of reconstruction and resilience. National frameworks such as Diia.City provide a shared enabling environment across these ecosystems.[9]

The table below summarises the more detailed descriptions of cities that follow.

**Table A2.2: Overview of city innovation concentrations**

| City | Energy | Transport / Mobility / Access | Digitalisation | Sustainable Cities (Infrastructure, Reconstruction, Resilience) | Cybersecurity, Cloud & AI |
|---|---|---|---|---|---|
| **Kyiv** | High | High | High | High | High |
| **Lviv** | Medium | Medium | High | Medium | High |
| **Dnipro** | High | Medium-High | Medium | High | Medium |
| **Kharkiv** | Medium | Medium | High | Medium | High |
| **Odesa** | Medium | High | Medium | High | Medium |
| **Vinnytsia** | Medium-High | Medium | Medium | High | Emerging |
| **Ivano-Frankivsk** | Medium-High | Medium | Medium | Medium-High | Emerging |
| **Kherson** | Emerging | Emerging | Limited | High | Limited |

### 2.2.1. Kyiv

Kyiv is Ukraine's primary innovation hub, combining a high concentration of startups, research institutions, investors, and public-sector actors. It hosts major innovation infrastructure such as UNIT.City, which serves as a platform for startups, R&D, and corporate innovation.[10]

The city is also a central node for energy innovation. The Energy Innovation Hub at Kyiv Polytechnic Institute focuses on decarbonisation, energy efficiency, and reconstruction-oriented research.[11] In parallel, Kyiv has developed advanced digital governance systems through initiatives such as Kyiv Smart City, which promotes open data and digital public services.[12]

9 Ministry of Digital Transformation of Ukraine. (n.d.). *Diia.City*. https://digitalstate.gov.ua/projects/govtech/diia-city
10 UNIT.City. (n.d.). *UNIT.City innovation park*. https://unit.city/en/
11 Kyiv Polytechnic Institute. (2025). *KPI Energy Innovation Hub*. https://kpi.ua/en/2025-seih
12 Kyiv Smart City. (n.d.). *Kyiv smart city initiative*. https://smartcitykyiv.com/en/

**Kyiv innovation ecosystem strengths and weaknesses**
Strengths: strong access to capital, talent, and policy; leadership in digitalisation and energy systems; high level of international integration. Weaknesses: high competition for resources; exposure to infrastructure and security risks.

### 2.2.2. Lviv

Lviv is one of Ukraine's strongest regional innovation centres, particularly in IT services, startups, and international collaboration. The Lviv IT Cluster plays a key role in coordinating business, education, and policy initiatives in the sector.[13]

The city is also home to IT Arena, a major international tech event that strengthens its position as a meeting point for startups, investors, and global partners.[14] Lviv's western location has contributed to its relative stability and attractiveness during the war.

**Lviv innovation ecosystem strengths and weaknesses**
Strengths: strong startup ecosystem, international connectivity, attractive environment for talent. Weaknesses: limited heavy industry; less direct role in large-scale energy systems.

### 2.2.3. Dnipro

Dnipro is a major centre for industrial innovation, with a strong legacy in aerospace, manufacturing, and engineering. The INNOVATION FORPOST industrial park reflects ongoing efforts to modernise industrial capacity and integrate new technologies.[15]

The Diia.Business Center in Dnipro further supports entrepreneurship, SME development, and digital transformation.[16] The city is therefore particularly relevant for industrial technology and reconstruction-driven innovation.

**Dnipro innovation ecosystem strengths and weaknesses**
Strengths: strong industrial base; relevance for advanced manufacturing and reconstruction. Weaknesses: smaller startup ecosystem; higher exposure to security risks.

### 2.2.4. Kharkiv

Kharkiv is a major centre for engineering, science, and higher education. The Kharkiv IT Cluster connects companies, universities, and institutions to support talent development and digital transformation.[17]

Institutions such as the Kharkiv Polytechnic Institute contribute to research and innovation capacity, particularly in engineering and digital technologies.[18] However, ongoing security challenges significantly affect the city's operational conditions.

13 Lviv IT Cluster. (n.d.). *Lviv IT cluster*. https://itcluster.lviv.ua/en/
14 IT Arena. (n.d.). *IT Arena 2026*. https://itarena.ua/
15 Dnipropetrovsk Investment Agency. (n.d.). *Dnipropetrovsk Investment Agency*. https://dia.dp.gov.ua/en/main-en/
16 Diia.Business Dnipro. (n.d.). *Diia.Business in Dnipro*. [Translated] https://diia-business-dnipro.com/
17 Kharkiv IT Cluster. (n.d.). *Benefits of participation in Kharkiv IT Cluster*. https://it-kharkiv.com/en
18 National Technical University "Kharkiv Polytechnic Institute." (n.d.). National Technical University "Kharkiv Polytechnic Institute." https://www.kpi.kharkov.ua/eng/

**Kharkiv innovation ecosystem strengths and weaknesses**
Strengths: strong technical education and research base; high-quality engineering talent. Weaknesses: significant infrastructure- and security challenges.

## 2.2.5. Odesa

Odesa's innovation profile is closely linked to its role as a major port and logistics hub. The Odesa Sea Port is one of the largest in the Black Sea region, making the city central to transport, trade, and supply chains.[19]

Regional development strategies emphasise resilience, recovery, and infrastructure modernisation.[20] Emerging projects, such as decentralised energy systems for port operations, highlight the intersection of energy and logistics innovation.[21]

**Odesa innovation ecosystem strengths and weaknesses**
Strengths: strong logistics and transport position; relevance for infrastructure resilience. Weaknesses: smaller startup ecosystem; vulnerability of critical infrastructure.

## 2.2.6. Vinnytsia

Vinnytsia is an emerging innovation centre with strong municipal leadership. The Crystal Innovation and Technology Park serves as a platform for startups, SMEs, and education, and is described as Ukraine's first municipal innovation park.[22]

The city demonstrates how local governance can support innovation, particularly in sustainable urban development and SME growth.[23]

**Vinnytsia innovation ecosystem strengths and weaknesses**
Strengths: strong local implementation capacity; integrated approach to innovation and urban development. Weaknesses: limited scale and international visibility.

## 2.2.7. Ivano-Frankivsk

Ivano-Frankivsk is a growing regional hub with a diversified economy that includes energy, industry, and agriculture.[24] The Ivano-Frankivsk IT Cluster supports the development of the digital sector through collaboration between business and education.[25]

19 Odesa Branch of the State Enterprise "Ukrainian Sea Ports Authority." (n.d.). *Odesa Sea Port Authority*. https://odesa.uspa.gov.ua/en/
20 Regional Development Agency of Odesa Region. (2025). *The strategy for the restoration and development of Odesa region was approved*. https://rdaod.com.ua/en/approved-development-strategy-of-odesa-region/
21 Ports Europe. (2026). *Lockheed Martin, QuinteQ Energy deliver decentralised microgrid for Odesa port*. https://www.portseurope.com/decentralised-microgrid-for-odesa-port-from-lockheed-martin-and-quinteq-energy/
22 Crystal Technopark. (n.d.). *Crystal Innovation and Technology Park*. https://www.crystal.vn.ua/en
23 Vinnytsia City Council. (2025). *Open for business: Ukraine's first municipal innovation and technology park 'Crystal' presented in Vinnytsia*. https://www.vmr.gov.ua/en/open-for-business-ukraines-first-municipal-innovation-and-technology-park-crystal-presented-in-vinnytsia
24 Ivano-Frankivsk Regional State Administration. (n.d.). *Invest in Ivano-Frankivsk region*. https://invest.if.gov.ua/en
25 Ivano-Frankivsk IT Cluster. (n.d.). *Ivano-Frankivsk IT Cluster*. https://it-cluster.if.ua/

The region's significant energy infrastructure and growing distributed-generation capacity make energy resilience and decentralisation particularly relevant to its development.[26]

**Ivano-Frankivsk innovation ecosystem strengths and weaknesses**
Strengths: diversified regional economy; growing IT ecosystem; relevance for energy resilience. Weaknesses: smaller scale; limited research and industrial depth.

### 2.2.8. Kherson

Kherson is primarily relevant in the context of recovery and resilience. The city and region have experienced extensive war-related infrastructure damage, creating substantial needs for reconstruction and the restoration of essential services.[27]

At the same time, recovery efforts involve innovation in governance, infrastructure, and community systems, making Kherson an important case for resilience-oriented innovation.[28]

**Kherson innovation ecosystem strengths and weaknesses**
Strengths: high relevance for reconstruction and resilience innovation. Weaknesses: limited current innovation ecosystem; ongoing security challenges.

26 Ivano-Frankivsk Regional State Administration. (2026). *Ivano-Frankivsk region is among the leaders in distributed generation development: 97.6 MW of capacity already installed in the region*. [Translated]. https://www.if.gov.ua/news/ivano-frankivshchyna-sered-lideriv-iz-rozvytku-rozpodilenoi-heneratsii-v-oblasti-vzhe-vstanovleno-976-mvt-potuzhnostei

27 Government of Ukraine, World Bank Group, European Commission, & United Nations. (2025). *Ukraine: Fourth rapid damage and needs assessment (RDNA4): February 2022–December 2024*. https://www.undp.org/ukraine/publications/ukraine-fourth-rapid-damage-and-needs-assessment-rdna4-february-2022-december-2024-english

28 Kherson Regional Charitable Fund "Union." (2025). *III Forum of Southern Ukraine "Government and Community: A Joint Path from Humanitarian Response to Recovery and Development."*. https://en.fundunion.org/2025/10/III-Forum-of-Southern-Ukraine.html

## 2.3. Private sector: companies, entrepreneurs and innovation capacity

Ukraine's private sector is one of the most important parts of the country's innovation capacity. While public institutions such as Diia, Brave1 and the WINWIN strategy provide enabling frameworks, much of Ukraine's practical innovation capability is in companies, start-ups, founders, engineers, investors and export-oriented business networks. The private sector has shown an unusual ability to operate under crisis conditions, maintain international client relationships, adapt business models, and develop new technologies under extreme pressure. This is especially visible in IT, digital services, defence technology, logistics, energy, agritech, fintech, cybersecurity, health innovation and reconstruction-related industries.

The private sector should therefore not only be understood as an economic actor. It is also an implementation and learning system. Many Ukrainian companies have become highly skilled at solving concrete problems quickly, integrating user feedback, working with international partners and turning scarcity into innovation. This is particularly relevant for the report's broader argument that Ukraine's innovation system should move from sector-based competitiveness toward a stronger focus on human-needs-driven innovation, resilience and improved living standards.

Ukraine's IT and digital sector remains the clearest example of private-sector innovation capacity. The sector has continued to generate significant export revenues despite the war. In 2024, Ukrainian IT exports were around USD 6.4–6.45 billion, according to IT Ukraine Association and National Bank of Ukraine figures, although this represented a decline from the wartime peak in 2022.[29,30] In the first half of 2025, telecommunications, computer and information services accounted for around 43% of Ukraine's services exports, with computer services remaining the largest component.[31] This demonstrates that even under wartime conditions, the Ukrainian private sector continues to provide globally competitive digital services.

The Diia.City framework is also important for understanding the scale and structure of the private innovation ecosystem. By September 2025, Diia.City had reached around 2,500 resident companies and more than 125,000 specialists, with residents paying almost UAH 20 billion in taxes during the first eight months of 2025.[32] By early 2026, the number of residents had reportedly grown to more than 3,700 companies, with IT representing around 77% of residents, followed by information services and transport equipment manufacturing.[33] This shows that Ukraine has created a legal and tax environment that is

29 IT Ukraine Association. (2025). *Ukraine's IT exports declined by over 4% in 2024. What's next?* https://itukraine.org.ua/en/ukraine-s-it-exports-declined-by-over-4-in-2024-what-next/

30 Interfax-Ukraine. (2025). *Ukrainian IT exports decrease by 4.2% in 2024 - National Bank.* https://interfax.com/newsroom/top-stories/109539/

31 Dev.ua. (2025). *In the first half of 2025, IT services accounted for almost half of all Ukrainian exports.* https://dev.ua/en/news/it-eksport-za-pershe-pivrichchia-2025-roku-1754999466

32 UNN. (2025). *The number of Diia.City residents reached 2,500, the budget received almost 20 billion hryvnias - Fedorov.* https://unn.ua/en/news/the-number-of-diiacity-residents-reached-2500-the-budget-received-almost-20-billion-hryvnias-fedorov

33 Opendatabot. (2026). *The number of Diia.City residents doubled in 2025.* https://opendatabot.ua/en/analytics/diia-city-2025

increasingly attractive for technology companies, including young firms and wartime innovation ventures.

### 2.3.1. Digital companies and globally recognised founders

Ukraine's private technology sector includes several companies that have achieved international visibility and demonstrate the country's ability to create globally relevant products. Grammarly is one of the best-known examples. Founded by Ukrainian entrepreneurs, Grammarly has become a global AI-based writing and communication platform and is often cited as one of Ukraine's most successful technology companies. Its founders represent a generation of Ukrainian entrepreneurs who built global technology companies while maintaining strong links to Ukrainian talent and engineering capacity.[34]

Preply is another important example. Founded by Ukrainian entrepreneurs, Preply has grown into a global online language-learning platform connecting learners and tutors internationally. It illustrates how Ukrainian start-ups can scale globally in education technology, marketplace models and digital services.[35] In a human-needs-driven innovation framework, Preply is relevant because it connects technology with education, skills, self-realisation and access to learning.

Ajax Systems is a particularly important example of hardware-based innovation, it develops professional security systems and has become one of Ukraine's most successful hardware technology companies. Its relevance has increased during the war because security, infrastructure protection and resilience have become central societal needs.[36] Ajax demonstrates that Ukraine's private innovation capacity is not limited to software outsourcing, but includes advanced product design, manufacturing, hardware integration and international market development.

MacPaw is another globally recognised Ukrainian technology company. It develops software products for Mac users and has also become known for its role in supporting Ukraine's digital and civic resilience during the war.[37] MacPaw is relevant because it demonstrates how private companies can combine commercial success, global product development and civic responsibility.

Petcube is an example of consumer hardware and IoT innovation. Reface, known for AI-based media and synthetic-content tools, demonstrates Ukraine's strength in AI, mobile applications and creative digital products. GitLab, co-founded by Ukrainian developer Dmitriy Zaporozhets, also illustrates how Ukrainian engineering talent has contributed to globally important developer infrastructure, even when companies later become internationally distributed.[38]

Together, these examples show that Ukraine has produced globally relevant private-sector innovators across AI, education technology, cybersecurity-adjacent hardware, developer

34 Grammarly. (n.d.). *The AI writing partner for work*. https://www.grammarly.com/about
35 Preply. (n.d.). *Powering people's progress*. https://preply.com/en/about-us
36 Ajax Systems. (n.d.). *We stand against evil*. https://ajax.systems/about/
37 MacPaw. (n.d.). *High four! We're MacPaw*. https://macpaw.com/about
38 TechUkraine. (n.d.). *Everything about Ukraine's tech sector in one place*. https://techukraine.org/

tools, consumer software and digital platforms. The strategic opportunity is to connect this entrepreneurial and engineering capability more directly to Ukraine's reconstruction needs, including energy systems, housing, health, education, mobility, public administration and local resilience.

### 2.3.2. Defence technology and dual-use innovation

The most dynamic part of Ukraine's private-sector innovation ecosystem today is defence technology. Since 2022, Ukraine has rapidly developed a defence-tech ecosystem involving drones, robotics, electronic warfare, AI, secure communications, sensors, unmanned surface vessels, autonomous systems and battlefield software. This ecosystem is largely driven by private firms and start-ups, but it is coordinated through state-backed platforms such as Brave1.

Brave1 has become one of the clearest examples of mission-oriented private-sector innovation in Ukraine. Launched in 2023, it brings together government, the military, developers, investors and technology companies. By 2025, Brave1 reported more than 1,500 companies and developers and more than 3,500 registered technology solutions, with around 90% of drone and ground robotics producers connected to the platform.[39] The Ministry of Digital Transformation also reported that Brave1 had awarded more than 540 grants worth around UAH 2.2 billion, with an additional UAH 2.9 billion planned in the 2025 national budget.[40]

Private defence-tech investment has also grown rapidly. In 2025, more than 50 Ukrainian defence-tech start-ups reportedly raised over USD 105 million in venture and angel funding.[41] Ukrainian start-ups such as Swarmer, Tencore, Dropla, Teletactica, M-Fly and Norda Dynamics have been highlighted among companies attracting investment in autonomous drones, UAV detection, command-and-control software, radio systems, tactical VTOL drones, and precision-weapons components. Swarmer, for example, reportedly raised USD 15 million in 2025 for autonomous drone swarm-control technology.[42]

The most important lesson from defence-tech is not only technological. It is institutional. Ukraine's defence-tech ecosystem shows that innovation accelerates when there is a clear user, urgent demand, rapid feedback, procurement pathways and an operational platform. This is directly relevant for civilian innovation. The same logic could be applied to energy resilience, rehabilitation, municipal services, housing, education and food systems. In other words, Ukraine's defence-tech innovation model could become a template for broader mission-oriented innovation if carefully adapted.

39 Ukrinform. (2025). *ShaBlia turrets, Rys platforms, Liut combat robot: Brave1 head speaks of defense tech solutions.* https://www.ukrinform.net/rubric-economy/3985226-shablia-turrets-rys-platforms-liut-combat-robot-brave1-head-speaks-of-defense-tech-solutions.html

40 Ministry of Digital Transformation of Ukraine. (2025). *Ukraine Launches Brave1 Market for Defense Innovation.* https://digitalstate.gov.ua/news/tech/brave1-market-ukrayina-zapuskaye-marketpleys-viyskovykh-innovatsiy

41 Kyiv Post. (2025). *Ukrainian defense startups raise over $105M in 2025 - Brave1.* https://www.kyivpost.com/post/65810

42 InVenture. (2025). *Ukrainian DefenceTech startups raise over $105 million in 2025.* https://inventure.com.ua/en/news/ukraine/ukrainian-defencetech-startups-raise-over-dollar105-million-in-2025

At the same time, there are risks. Defence innovation is shaped by wartime urgency and military demand. Without deliberate governance, civilian spillovers may remain accidental. Ukraine's challenge is therefore to convert parts of this war-driven innovation capacity into peace-oriented systems for resilient communities, infrastructure protection, disaster response, logistics, demining, energy resilience and public safety.

### 2.3.3. Energy and industrial innovation

Ukraine's private energy sector is central to reconstruction and resilience. DTEK, Ukraine's largest private energy company, is one of the most important actors. In 2025, DTEK selected Fluence Energy to deliver a 200 MW / 400 MWh battery energy storage portfolio across six sites in Ukraine, with a reported investment of around EUR 140 million. The project was described as the largest operational energy storage portfolio in Eastern Europe at the time of commissioning and as a major step toward strengthening Ukraine's energy security and grid stability.[43] This is highly relevant for a situation where Ukraine's old, centralised energy model cannot simply be rebuilt, but where flexibility, storage, resilience and distributed capacity is needed.

The GreenTech sector strategy developed within the WINWIN framework also points to a broader private-sector opportunity. It identifies renewable energy, hydrogen, energy storage, smart grids, electric transport, biofuels, critical materials and AI-supported energy systems as strategic areas for Ukraine's integration into Europe's energy architecture.[44] The private sector will be essential for turning these priorities into products, services, infrastructure and export capacity.

Ukraine also has strong industrial and agribusiness firms that could become important innovation actors in the green transition. Companies such as Kernel, MHP and other large agricultural and food-sector firms have potential relevance for bioenergy, biomethane, circular material flows, food security and resilient rural development. Industrial companies linked to metallurgy, machinery, logistics and manufacturing could become important in reconstruction supply chains, energy equipment, modular infrastructure and green industrial upgrading. The opportunity is to connect these firms more systematically to mission-oriented innovation programmes rather than treating them only as traditional industrial actors.

For Sweden–Ukraine cooperation, private-sector energy and industrial innovation could become one of the most important collaboration areas. Swedish companies and research actors have strengths in district heating, bioenergy, smart grids, industrial energy efficiency, heat pumps, digital energy systems, storage integration and circular industrial systems. Ukrainian companies bring urgent deployment environments, engineering capacity, reconstruction demand and resilience experience. Together, they could develop exportable solutions for resilient energy systems, municipal infrastructure and energy-secure public services.

43 Nasdaq. (2025). *DTEK selects Fluence to deliver 200 MW advanced energy storage systems in Ukraine.* https://www.nasdaq.com/press-release/dtek-selects-fluence-deliver-200-mw-advanced-energy-storage-systems-ukraine-2025-01

44 Ministry of Digital Transformation of Ukraine. (2025). *WINWIN GreenTech: Technologies for energy independence and green growth.* https://digitalstate.gov.ua/news/govtech/winwingreentech-tekhnolohiyi-dlia-enerhetychnoyi-nezaleznosti-ta-zelenoho-rozvytku

### 2.3.4. Logistics, infrastructure and service innovation

Ukraine's private logistics sector has become a major resilience actor during the war. Companies such as Nova Poshta have played an important role in maintaining delivery, logistics, business continuity and social connection under extreme conditions. Although not always framed as innovation in a narrow R&D sense, this kind of operational resilience is central to Ukraine's innovation capacity. Logistics companies develop routing systems, warehouse models, digital interfaces, emergency delivery processes and customer-facing services that help maintain everyday life during disruption.

This matters because innovation for better lives is not only about frontier technology. It is also about maintaining access to goods, medicines, services and economic participation. Private companies that keep logistics, payments, communications, repair services, construction supply chains and food systems functioning are part of Ukraine's lived resilience infrastructure.

This is particularly relevant for municipalities and reconstruction. Many of the most important innovations needed in Ukraine will require private-sector delivery capacity: construction firms, engineering companies, digital service providers, logistics operators, energy-service companies, repair firms, manufacturers and local SMEs. Research and innovation cooperation should therefore not only involve universities and start-ups, but also private firms that can implement and scale solutions in real-world environments.

### 2.3.5. Investors, accelerators and ecosystem builders

Ukraine's private innovation ecosystem also depends on investors, accelerators, venture funds and ecosystem builders. The growth of defence-tech investment in 2025 illustrates that international and domestic investors are increasingly paying attention to Ukrainian technology. Active investors in Ukrainian defence-tech have included funds and networks such as Freedom Fund VC, Green Flag Ventures, MITS Capital, D3, UA1 VC, United Angels Network and others.[41,45] In the broader technology ecosystem, Ukraine also benefits from organisations such as TechUkraine, IT Ukraine Association, UNIT.City, Lviv IT Cluster, Kharkiv IT Cluster and other ecosystem platforms.

These actors are important because they help connect companies to talent, capital, customers, international partners and policy processes. They also help create narratives about Ukraine as a technology nation rather than only a reconstruction recipient. This is especially important for attracting investment during wartime, when perceived risk remains high.

For Sweden, collaboration with Ukrainian investors and ecosystem builders could help identify companies with strong potential for joint pilots, market entry, R&D cooperation and export-oriented scaling. Swedish actors such as Vinnova, the Swedish Energy Agency, RISE, AI Sweden, Swedish incubators, business Sweden, private investors and industrial companies could benefit from more systematic links to Ukrainian venture and innovation networks.

45 EY. (2025). *Navigating Ukraine's defense tech market*. https://www.ey.com/content/dam/ey-unified-site/ey-com/en-ua/insights/defense-tech/navigating-ukraine-defense-tech-market.pdf

### 2.3.6. Key individuals and leadership capacity

Several private-sector founders and technology companies have contributed to Ukraine's international innovation reputation. The global reach of companies such as Grammarly, Preply, Ajax Systems, MacPaw, Petcube, Reface and GitLab-linked engineering communities demonstrates the international relevance of Ukrainian technology and engineering talent.[38,46] These individuals matter not only because of their companies, but because they can act as role models, investors, mentors, diaspora connectors and advocates for Ukraine's innovation ecosystem.

In the defence-tech and resilience space, founders and engineers behind companies such as Swarmer, Himera, Dropla, Tencore and other firms emerging from Ukraine's defence-tech ecosystem represent a new generation of wartime innovators.[42,47] Their experience is different from traditional start-up experience because products are tested under immediate operational pressure and user feedback can arrive directly from the battlefield. This gives Ukrainian innovators a distinctive competence in rapid iteration, reliability under stress and mission-focused product development.

The strategic question is how to connect these individuals to a broader national innovation agenda. Ukraine needs to make sure that successful founders and private-sector leaders become part of structured mentorship, investment, education and policy-design processes. This could include founder councils, diaspora investor networks, public-private mission boards, university entrepreneurship programmes and international advisory groups.

### 2.3.7. Strategic implications for Ukraine's innovation capacity

The private sector is one of Ukraine's greatest innovation strengths. It combines global digital competence, wartime problem-solving, operational resilience, entrepreneurial culture and growing integration into European and global markets. However, it also faces major constraints, including war risks, export restrictions, access to capital, talent loss, regulatory uncertainty, infrastructure damage and fragmentation between public, private and research actors.

A central weakness is that private-sector innovation is still too often assessed through narrow indicators such as exports, start-up valuations, investment rounds or number of companies. These are important, but they do not fully capture whether innovation improves living standards and creates opportunities for self-realisation. A human-needs-driven innovation agenda would ask how private-sector capabilities can contribute to warm homes, resilient hospitals, better schools, safer communities, affordable energy, accessible mobility, functioning local economies and flourishing lives.

Moving forward, Ukraine and its partners should treat private companies as co-designers of mission-oriented innovation, not only as beneficiaries of business support. This means creating structured roles for private firms in energy resilience missions, reconstruction

46 IT Ukraine Association, & Top Lead. (2025). *Digital Tiger 2024: The market power of Ukrainian IT*. https://itukraine.org.ua/files/DigitalTiger2024.pdf

47 Oliinyk, D. (2026). Digital transformation of Ukraine's economy: December 2025 [in Ukrainian]. National Institute for Strategic Studies. https://niss.gov.ua/news/komentari-ekspertiv/tsyfrova-transformatsiya-ekonomiky-ukrayiny-hruden-2025-roku

pilots, municipal innovation clusters, AI and digital public-service programmes, rehabilitation ecosystems, food-security initiatives and export-oriented industrial partnerships.

### 2.3.8. Sweden–Ukraine private sector cooperation

For Sweden–Ukraine cooperation, this creates a clear opportunity. Sweden should engage not only ministries and universities, but also Ukrainian companies, founders, investors and sector clusters. A dedicated private-sector track in collaboration programmes could identify Ukrainian firms in energy, digitalisation, AI, cybersecurity, logistics, health, food systems and reconstruction technologies that are suitable for Swedish partnerships. It could then connect them to Swedish testbeds, research institutes, companies, municipalities, investors and innovation agencies.

The strategic conclusion is that Ukraine's private sector is not simply an economic recovery engine. It is one of the core platforms for Ukraine's future innovation system. If connected more deliberately to public missions, research capacity and international partnerships, it can help Ukraine move from crisis-driven innovation toward globally relevant solutions for resilient and flourishing societies.

## 2.4. The Ukrainian diaspora

One of Ukraine's most important, but still underused, innovation resources are its global diaspora. The full-scale Russian invasion has transformed the scale, geography and strategic relevance of Ukrainian communities abroad. By September 2025, UNHCR estimated that around 5.75 million refugees from Ukraine were recorded globally, including around 5.2 million in Europe, while around 3.75 million people remained internally displaced inside Ukraine.[48]

Eurostat reported that, at the end of November 2025, 4.33 million non-EU citizens who had fled Ukraine had temporary protection status in the EU, with the largest numbers in Germany (1.241 million), Poland (968,750) and Czechia (392,670).[49] Statista, drawing on UNHCR data, has also described the broader displacement as involving almost 7 million Ukrainians abroad earlier in the war period, with Germany, Poland and Czechia among the main destination countries.[50]

The post-2022 diaspora builds on an older Ukrainian global diaspora. ICMPD notes that the Ukrainian diaspora worldwide was estimated at around 6 million people before the latest displacement wave, with roughly 20 percent residing in the EU.[51] This means that Ukraine's current diaspora is not only a refugee population. It is also a distributed transnational ecosystem of researchers, engineers, entrepreneurs, students, digital specialists, public-sector professionals, health workers, cultural actors and civic organisers. For a country whose innovation strategy stresses improved living standards and opportunities for self-realisation, this diaspora should be understood as part of Ukraine's innovation capacity, not only as a demographic loss.

The diaspora is highly unevenly distributed but strategically located. The largest post-2022 refugee and temporary-protection communities are in Germany, Poland and Czechia, while important Ukrainian communities also exist in Italy, Spain, the United Kingdom, the Baltic states, the Nordic countries, Canada and the United States. This geographical spread matters because Ukrainian researchers, innovators and entrepreneurs are now embedded in many of the world's strongest research and innovation ecosystems. The result is a form of distributed Ukrainian capacity across European universities, innovation hubs, start-up environments, technology firms, civil society organisations and public-sector institutions.

For Ukraine's research and innovation system, the central question is therefore not only how to encourage physical return after the war. It is also how to enable structured contribution from abroad. Ukraine needs to avoid a narrow "brain drain" framing and instead develop a "brain circulation" model where diaspora researchers, innovators and entrepreneurs can contribute through dual affiliations, joint projects, mentoring, investment, temporary return, remote collaboration, start-up networks and institutional

48 United Nations High Commissioner for Refugees. (2025). *Ukraine emergency.* UNHCR. https://www.unhcr.org/emergencies/ukraine-emergency

49 Eurostat. (2026). *Temporary protection for 4.33 million in November 2025.* European Commission. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20260112-1

50 Buchholz, K. (2025*). In three years of war, almost 7 million Ukrainians have fled.* Statista. https://www.statista.com/chart/26960/number-of-ukrainian-refugees-by-target-country/

51 Hincu, D. (2022). *The diaspora response to war in Ukraine.* International Centre for Migration Policy Development. https://www.icmpd.org/blog/2022/the-diaspora-response-to-war-in-ukraine

partnerships. This is especially important because the report already identifies talent loss, weak commercialisation, fragmented institutions and limited municipal innovation capacity as core weaknesses in Ukraine's innovation ecosystem.

### 2.4.1. Academics and researchers in the diaspora

The academic diaspora deserves specific attention because universities and research institutions are central to Ukraine's long-term innovation capacity. Ukrainian academics abroad include scholars who left before 2022 as part of earlier migration waves and those who were forced to leave because of the full-scale invasion. The newer group often maintains strong emotional, professional and institutional links to Ukraine, while simultaneously trying to continue their research careers in host countries.

A growing body of research shows that forced academic migration from Ukraine is not simply a question of individual displacement. It affects professional identity, career pathways, institutional links and the future of Ukrainian science. A 2025 study in *Central and Eastern European Migration Review* argues that any serious discussion of the future of Ukrainian academia must be based on an understanding of displaced academics' experiences, behavioural strategies and changing professional self-identification under forced migration.[52] Another study on migration trajectories of Ukrainian scholars abroad finds that many displaced researchers pursue a dual strategy: maintaining professional links with Ukrainian universities while simultaneously seeking opportunities abroad.[53] This is highly relevant for innovation policy because it suggests that many Ukrainian academics are not "lost" to Ukraine, but remain part of a transnational academic system if adequate institutional channels exist.

Several initiatives already aim to support this kind of transnational science system. The Ukrainian Science Diaspora platform, hosted through Ukraine's national science infrastructure, states that its mission is to unite Ukrainian scholars from different migration waves for the reconstruction and development of Ukraine and for better integration of Ukrainian scholars into the global research community. At the time of access, the platform reported that 431 scientists had joined and offers functions related to science diplomacy, analytics and policy briefs, mentorship, stories and digital tools.[54]

The Ukrainian Ministry of Education and Science describes the initiative as aimed at strengthening institutional cooperation between Ukrainian and foreign higher education and research institutions, supporting post-war recovery through science and increasing the international visibility of Ukrainian science.[55] The OECD STIP Compass similarly lists the Ukrainian Scientific Diaspora initiative as a policy initiative to promote cooperation between Ukrainian scientists abroad and scientific institutions in Ukraine.[56]

52 Kiselyova, Y., & Ivashchenko, V. (2025). *Ukrainian academics in forced migration caused by the Russian–Ukrainian war: Problems of identity*. Central and Eastern European Migration Review, 14(1), 139–159. https://doi.org/10.54667/ceemr.2025.06

53 Jaroszewicz, M., Shkoda, T., & Ovchynnikova, O. (2025). Migration trajectories of Ukrainian scholars abroad: Forced academic mobility. Population, Space and Place, 31(2), Article e70011. https://doi.org/10.1002/psp.70011

54 Ukrainian Science Diaspora. (n.d.). *Our Mission.* https://ukrdiaspora.nauka.gov.ua/en/

55 Ministry of Education and Science of Ukraine. (n.d.). *Ukrainian Science Diaspora.*[Translated]. https://mon.gov.ua/nauka/nauka-2/ukrainska-naukova-diaspora

56 OECD. (2025). *Initiative "Ukrainian Scientific Diaspora"*. STIP Compass. https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2025%2Fdata%2FpolicyInitiatives%2F99998472

Sweden is relevant in this context. Sweden is already a founding member of the Coalition for Science, Research and Innovation in Ukraine, launched through the Rome Declaration, which aims to support Ukrainian scientists and innovators through joint research projects and Ukraine's integration into the European Research Area.[57] Swedish universities are also already involved in Ukraine-related academic cooperation, including Lund University's Lund-Ukraine Alliance for Academic Support, Umeå University's Erasmus+ cooperation with Ukrainian universities, and Linköping University's work on public-service resilience and local governance. These initiatives could become stronger if linked explicitly to Ukrainian academics in Sweden and to the broader Ukrainian Science Diaspora infrastructure.

A particularly relevant new development is the establishment of the association Ukrainian Scientists in Sweden in April 2026. The association aims to bring together Ukrainian researchers, scientists and innovators living and working in Sweden, develop professional networks, support scientific and innovation activities, and foster cooperation between Ukrainian and Swedish academic, educational and societal environments.[58] This creates a concrete platform for Sweden to engage Ukrainian academic diaspora capacity in a more structured way.

For Sweden–Ukraine cooperation, the academic diaspora could play at least five roles. First, diaspora researchers can help identify high-quality Ukrainian research partners and reduce transaction costs for Swedish universities and research institutes. Second, they can support joint research applications to Horizon Europe, MSCA, Swedish funding bodies and bilateral programmes. Third, they can contribute to doctoral supervision, mentoring and research training for Ukrainian students and early-career researchers. Fourth, they can help build thematic bridges in areas where Sweden and Ukraine have shared strategic interests, including energy resilience, AI, cybersecurity, health innovation, public administration, life sciences, food systems and municipal reconstruction. Fifth, they can act as science-diplomacy actors who help explain Ukrainian research needs and opportunities to Swedish and European institutions.

The main risk is that Ukrainian academics abroad gradually become disconnected from Ukrainian institutions because of better funding, safer working conditions and clearer career pathways in host countries. To avoid this, Ukraine and its partners should support dual appointments, visiting positions, return fellowships, remote teaching mechanisms, joint laboratories, shared doctoral schools and research infrastructure access. Sweden could play a particularly useful role by linking the Ukrainian academic diaspora in Sweden to Swedish universities, RISE, Vinnova, the Swedish Energy Agency, Formas, Forte, Sida, the Swedish Institute and relevant municipal innovation platforms.

57 Government Offices of Sweden. (2025). *Sweden is a founding member of the initiative Coalition for Science, Research and Innovation in Ukraine.* https://www.government.se/press-releases/2025/07/sweden-is-a-founding-member-of-the-initiative-coalition-for-science-research-and-innovation-in-ukraine/

58 Ukrainian Science Diaspora. (2026). *Association "Ukrainian Scientists in Sweden" has been established.* https://ukrdiaspora.nauka.gov.ua/en/news/u-shveciyi-stvoreno-spilku-ukrayinski-vcheni-v-shveciyi/

### 2.4.2. Entrepreneurs, start-ups and business networks in the diaspora

The entrepreneurial diaspora is equally important. Ukrainian refugees and migrants are not only workers in host economies; many are also business founders, freelancers, investors, mentors and innovation intermediaries. Evidence from Poland is particularly important because Poland hosts one of the largest Ukrainian communities in Europe. A CEPR/VoxEU study on refugee entrepreneurs in Poland finds that Ukrainians started 38,833 firms in 2022–2023, accounting for 7 percent of all new firm registrations in Poland. The study also finds that 58 percent of post-invasion Ukrainian founders in the survey reported arriving as refugees, and that a 10 percent increase in Ukrainian firm registrations led to 2.3% more Polish firms, suggesting that Ukrainian refugee entrepreneurs stimulated rather than crowded out local entrepreneurship.[59] The same study reports mechanisms such as emulation and supply-chain linkages, with many Ukrainian firms selling to or buying from other firms in Poland.

This is important for Ukraine because it shows that displaced Ukrainians can become "business multipliers" in host economies. From an innovation-system perspective, this means the diaspora can help create international market access, supplier networks, investment relationships and entrepreneurial learning that later benefit Ukraine. Rather than viewing refugee entrepreneurship only as integration into host countries, Ukraine and its partners should view it as part of a distributed Ukrainian business and innovation network.

Several initiatives already support this direction. The Ukrainian Hub supports displaced Ukrainian entrepreneurs through training, consulting, mentoring, international start-up ecosystems, incubators and access to venture and private funds. At the time of writing, it reports work in Ukraine, Portugal and the United States, with more than 500 programme participants, and more than 30 new businesses launched. The Empower Ukrainian Entrepreneurs initiative frames diaspora entrepreneurship as a way to support business growth, job creation and international collaboration, with a particular focus on women-led businesses.[60] The YoU Embrace programme, part of Erasmus for Young Entrepreneurs, is another example of an entrepreneurship bridge, connecting Ukrainian young entrepreneurs with experienced entrepreneurs in European countries such as Austria, Italy, Czechia and Germany.[61]

These entrepreneurial platforms should be connected more directly to Ukraine's research and innovation agenda. Diaspora entrepreneurs can help Ukrainian start-ups enter new markets, validate products, find investors, recruit talent and build partnerships with European firms. They can also help identify which Ukrainian technologies have international potential in areas such as energy resilience, digital public services, cybersecurity, defence-related dual-use technologies, health-tech, rehabilitation, food systems, logistics and reconstruction technologies.

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59 Vézina, P.-L., Aksoy, C. G., & Lewandowski, P. (2025). *Refugee entrepreneurs as business multipliers: Evidence from Ukrainians in Poland.* CEPR/VoxEU. https://cepr.org/voxeu/columns/refugee-entrepreneurs-business-multipliers-evidence-ukrainians-poland

60 Ukrainian Hub. (n.d.). *Empower Ukrainian entrepreneurs – Stimulate Overall Growth.* https://ukrainianhub.org/en/empower-ukrainian-entrepreneurs/

61 YoU Embrace. (n.d.). *YoU Embrace – A mentoring program for Ukrainian young entrepreneurs.* https://www.youembrace.eu/

### 2.4.3. Diaspora integration initiatives and policy learning

Diaspora integration itself is becoming an object of policy innovation. The Stockholm School of Economics in Riga launched a Ukrainian Diaspora Integration project, originally planned for 2024/25, to establish a network involving academics, policymakers, the business community and displaced Ukrainians in Europe. The project aimed to support regular meetings, data sharing, collaborative initiatives, knowledge exchange and sustainable strategies for integration, with activities in several European countries.[62] This kind of multi-stakeholder integration platform is relevant for Ukraine's innovation agenda because it treats displaced Ukrainians not only as beneficiaries of support, but as actors in policy learning and institutional development.

ICMPD's analysis of the diaspora response to the war also highlights that diaspora actors have contributed through humanitarian support, labour-market orientation, entrepreneurship, mentorship, information sharing, advocacy, fundraising, social media mobilisation and links to employment platforms.[63] This broader crisis-response capacity matters for innovation because it shows that diaspora organisations can act quickly, mobilise trust, translate across systems and connect formal institutions with affected communities. These capabilities are valuable not only during the emergency phase, but also during reconstruction and long-term transformation.

The Warwick Ukrainian Diaspora project is another relevant example. It examines how diaspora engagement can support Ukraine's recovery and international partnerships, including through policy-relevant research, civic networks and connections between displaced Ukrainians and institutions in host countries.[64] Such initiatives can help move diaspora engagement from informal support toward structured innovation and reconstruction cooperation.

### 2.4.4. The Swedish dimension

Sweden has a smaller Ukrainian refugee community than Germany, Poland and Czechia, but it is strategically relevant because Sweden has strong research institutions, innovation agencies, digital-government capabilities, energy-system expertise, municipal governance capacity and a growing set of Ukraine-related cooperation initiatives. Eurostat data show that Sweden is one of the EU countries where temporary-protection numbers have fluctuated significantly because of renewal processes, with a large increase of 9,345 people recorded in April 2025 after an earlier renewal-related decrease.[65]

The Swedish Government's 2024 follow-up report on Ukrainians in Sweden, based on IOM survey work, found positive developments in almost all comparable areas: 66% of working-age respondents stated that they participated in the labour market, up from 56% the previous year, and 47% stated that they could speak Swedish, compared with 26% the

62 Stockholm School of Economics in Riga. (2025). *Ukrainian diaspora integration.* https://www.sseriga.edu/ukrainian-diaspora-integration

63 Hincu, D. (2022). *The diaspora response to war in Ukraine.* International Centre for Migration Policy Development. https://www.icmpd.org/blog/2022/the-diaspora-response-to-war-in-ukraine

64 University of Warwick. (n.d.). *Engaging the Global Ukrainian Community for Ukraine's Recovery.* https://warwick.ac.uk/fac/soc/pais/research/projects/ukrainiandiaspora/psf2/

65 Eurostat. (2025). *Temporary protection for 4.26 million people in April.* European Commission. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20250610-1

previous year.[66] These figures suggest that Ukrainians in Sweden are increasingly becoming part of Swedish labour-market and social systems.

From a research and innovation perspective, Sweden should not treat this community only through labour-market integration policy. It should also identify researchers, engineers, entrepreneurs, students and professionals who can contribute to Swedish–Ukrainian innovation cooperation. The new Ukrainian Scientists in Sweden association provides an important entry point for this. So do existing Sweden–Ukraine initiatives such as the Coalition for Science, Research and Innovation in Ukraine, the SI Ukraine Cooperation Programme, InnovationBridge, WIRNU, Beetroot Academy support, Swedish university partnerships and energy-resilience projects.

For Sweden, an opportunity is to connect Ukrainian entrepreneurs in Sweden and the Nordic region with Swedish innovation infrastructure. This could include incubators, science parks, university innovation offices, AI Sweden, RISE, Sting, Norrsken, Vinnova-supported programmes, municipal innovation labs, Swedish Energy Agency initiatives and Ukraine-focused programmes such as TechStep Sweden. A Sweden–Ukraine diaspora entrepreneurship track could focus on sectors where Sweden has strong system knowledge and Ukraine has urgent use cases, such as resilient energy systems, circular reconstruction, AI for public services, rehabilitation technologies, sustainable food systems and cybersecurity.

A concrete next step could therefore be to develop a Sweden–Ukraine Diaspora Innovation Track with three functions. The first would be mapping: identifying Ukrainian researchers, innovators and entrepreneurs in Sweden by field, region, institution and interest in Ukraine-related cooperation. The second would be mobilisation: connecting them to Swedish and Ukrainian research calls, municipal partnerships, innovation clusters and start-up programmes. The third would be acceleration: supporting diaspora-led or diaspora-enabled projects in priority areas such as resilient energy systems, AI, cybersecurity, public-sector digitalisation, rehabilitation, food security, education and municipal reconstruction.

Such a track should not be limited to return migration. Many Ukrainians may remain in Sweden for years, while still wanting to contribute to Ukraine. The goal should therefore be flexible engagement: physical return where possible, temporary return where useful, and remote or transnational contribution where most effective. This would align well with the broader report's argument that durable innovation cooperation depends on skills, networks, trust and institutional relationships, not only on funding or hardware.

### 2.4.5. Strategic implications for Ukraine's innovation capacity

The Ukrainian diaspora should be treated as one of the key missing layers in Ukraine's innovation capacity analysis. It directly affects several SWOT dimensions identified in this report. It can mitigate brain drain by enabling brain circulation. It can strengthen international integration by linking Ukraine to universities, firms, investors and policy communities abroad. It can support commercialisation by helping Ukrainian start-ups enter foreign markets. It can strengthen reconstruction by bringing knowledge from host-country

66 Government Offices of Sweden. (2024, July 25). *New report on the situation of Ukrainians in Sweden.* https://www.government.se/press-releases/2024/07/new-report-on-the-situation-of-ukrainians-in-sweden/

systems into Ukrainian reform and rebuilding processes. It can also support a human-needs-driven innovation agenda by connecting Ukrainian lived experience with international expertise in health, housing, energy, education, local governance and social resilience.

Moving forward, Ukraine and its partners should develop a more systematic diaspora innovation agenda. This could include a global registry of Ukrainian researchers and innovators linked to the Ukrainian Science Diaspora platform; dedicated diaspora windows in research and innovation calls; dual-affiliation mechanisms for Ukrainian academics abroad; diaspora entrepreneurship funds; mentorship networks; temporary return fellowships; municipal innovation partnerships involving diaspora professionals; and targeted Sweden–Ukraine pilots linked to the Ukrainian Scientists in Sweden association.

The strategic conclusion is that Ukraine's diaspora is not only a consequence of war. It can become one of the foundations of Ukraine's future innovation system. If properly connected to Ukraine's reconstruction, EU integration and WINWIN innovation agenda, the diaspora can help Ukraine move from crisis-driven survival innovation toward globally connected, human-needs-driven innovation for flourishing lives and a flourishing planet.

## 2.5. SWOT assessment of Ukraine's innovation ecosystem

Below is a SWOT assessment of Ukraine's innovation capacity and needs, based on the findings in this report.

### 2.5.1. Strengths

***A. High adaptive innovation capacity under extreme conditions***

Ukraine has demonstrated stress-tested innovation capacity through rapid advances in defence technology, drones, artificial intelligence, cybersecurity and logistics, coupled with real-time deployment under crisis conditions. This gives parts of Ukraine's wartime innovation ecosystem distinctive experience in rapid, mission-focused development under operational pressure. Ukraine has unusual, documented experience of turning immediate operational feedback into deployed solutions under urgency and scarcity.

***B. Strong human capital and digital foundation***

A deep pool of engineers, IT professionals and scientists, a competitive IT outsourcing and startup ecosystem, and advanced digital public infrastructure such as Diia provide strong upstream capacity and an enabling base for scaling digital solutions. However, these assets do not automatically produce commercialisation, scale or better societal outcomes. Stronger links to implementation, public services and tangible improvements in daily life are still needed to turn technical and digital capacity into a complete innovation system.

***C. Advanced government-led innovation platforms***

Diia and Brave1 show that Ukraine can build functioning innovation ecosystems when missions, users, feedback and participation interfaces are clear. They also demonstrate that state capacity can be strong when operational urgency is translated into a defined mission and usable coordinating platform. The same organising logic could support energy resilience, reconstruction, municipal services, healthcare and education, where coordinated, user-focused innovation is also required.

***D. Strong international integration and support***

Integration with Horizon Europe, the European Research Area and wider European frameworks gives Ukraine access to funding, networks, reform pathways and partnerships, including growing links with Sweden. Participation is nevertheless uneven and constrained by administrative complexity and wartime conditions. These connections mean Ukraine is not rebuilding in isolation: they provide knowledge, finance and institutional support, while allowing international partners to learn from Ukraine's experience of resilience, security, digital governance and innovation under disruption.

***E. Potential global resilience testbed***

Ukraine offers real-world environments for resilience innovation in energy systems under attack, crisis digital governance and cyber-physical security. This creates globally relevant innovation potential extending beyond national recovery, although many approaches remain pilots or future pathways rather than mature systems operating at scale. Claims about Ukraine as a testbed should therefore distinguish demonstrated experience from prospective scaling opportunities.

***F. Private-sector delivery and scaling capacity***
Much of Ukraine's practical innovation capacity lies in companies and business networks. Technology firms contribute rapid problem-solving and logistics providers help maintain essential services, while construction, engineering, energy-service and SME actors provide delivery capacity. Investors and ecosystem builders connect firms to capital and partners. The private sector therefore bridges technical capability and public platforms with real-world delivery and scaling. But war risk, limited capital, talent loss, infrastructure damage and fragmentation constrain this role, making stronger public-private-research collaboration essential.

***G. Rehabilitation and human-capability innovation ecosystems***
Superhumans illustrates how advanced prosthetics, rehabilitation, healthcare, architecture, psychological support, employment and social reintegration can form an innovation ecosystem centred on restored human capability. It broadens Ukraine's innovation narrative beyond defence, digital government and infrastructure to include dignity, participation, self-realisation and rebuilding lives. This is human-needs-driven innovation in practice: technology and services are organised around helping people recover capability and imagine a future beyond survival.

### 2.5.2 Weaknesses

***A. Structural misalignment between innovation and better lives***
Ukraine's innovation system remains more strongly organised around sectors, technologies, competitiveness, exports and startups than around lived outcomes. These outputs do not automatically improve housing quality, energy affordability, health, wellbeing or opportunities for self-realisation, leaving a persistent gap between innovation capacity and better daily lives. The central challenge is to shift from innovation as sectoral growth towards innovation as a system for delivering better lives.

***B. Weak commercialisation and scaling mechanisms*** Weak technology transfer, limited venture-capital depth, fragmented innovation-to-market pathways and insufficient routes from research or prototypes to durable implementation restrict economic and societal impact. Recovery requires not only ideas but repeatable models, financeable solutions, market pathways and institutions able to scale what works. Without stronger scaling mechanisms, technical and entrepreneurial capacity is likely to continue underperforming systemically.

***C. Fragmentation and coordination challenges*** Ukraine's many public, private, research, local and international actors create dynamism but also fragmented ownership and missions. Ukraine's innovation capacity is distributed across many actors, but coordination and integrated execution remain uneven. In energy, reconstruction and municipal innovation, weak orchestration risks leading to duplication, isolated pilots, underused data and limited learning across national strategy, local delivery, research, finance and private-sector implementation.

***D. Uneven and underused municipal and local innovation capacity***
Municipalities encounter needs in energy, housing, water, transport, public buildings and recovery most directly, yet their resources, autonomy, technical capacity and involvement in

innovation design are uneven. This matters because national strategies ultimately deliver outcomes through local systems and services. Treating cities only as implementers rather than co-designers weakens innovation in the everyday systems through which better lives are delivered.

***E. Talent loss and demographic pressure***

Brain drain, forced displacement of researchers and professionals, and ageing in some regions weaken firms, universities, research institutions and local ecosystems while complicating long-term planning. Diaspora engagement and EU mobility can mitigate these pressures but cannot remove them without deliberate brain-circulation and contribution channels.

***F. Damaged scientific infrastructure and constrained long-term R&D capacity***

Underinvestment, reduced R&D capacity, damaged scientific infrastructure and fragmented links among universities, research institutes, industry and policy place Ukraine's long-term knowledge base under severe pressure despite its strong scientific talent. The danger is that human capital and wartime problem-solving will not become durable research capability or long-term institutional learning. Strengthening research infrastructure, doctoral training, interdisciplinary partnerships and science-industry-policy links could help connect immediate resilience with commercialisation and long-term transformation.

***G. Systemic energy innovation gap***

Energy is still often treated mainly as infrastructure, supply, security, technology or market design rather than as a life-support system enabling warm homes, healthcare, education, water, mobility, communications and livelihoods. Innovation is not yet consistently assessed against affordability, thermal comfort, public health, service continuity and local resilience. This separates energy as a technical sector from energy as a foundation for better lives and leaves a major gap for future research and collaboration.

## 2.5.3 Opportunities

***A. Long-term, large-scale mission-driven projects***

Ukraine's reconstruction and transformation require a shift from fragmented short-term pilots towards 10- to 15-year missions integrating research, innovation, deployment and infrastructure. Priorities could include energy-positive reconstruction districts, resilient municipal systems combining energy, water and mobility, energy-secure hospitals and schools, and integrated digital-physical infrastructure. Stable investment, continuity and institutional memory could allow successful approaches to develop beyond short funding cycles.

***B. Alignment of innovation with Ukrainian priority needs***

Organising innovation around life systems rather than sectors would better connect it to energy affordability and resilience, housing and thermal comfort, health systems, mobility and access, and food systems. Flourishing life-years could provide a practical lens for asking how each project improves daily life, resilience, affordability and wellbeing. This would turn the wider ambition of better living standards into assessment and design criteria.

***C. Multilateral coordinated projects***
Mission-aligned, multi-country platforms could coordinate funding, standards and testbeds across otherwise fragmented bilateral and EU programmes. A resilient energy programme could combine Ukraine's deployment environments, Swedish systems integration and governance, German industrial and manufacturing capabilities and EU funding. Such coordination could reduce duplication, increase scale, accelerate EU integration and generate shared European resilience knowledge.

***D. Civilian transformation of war-driven innovation***
Ukraine can deliberately translate war-driven capabilities into civilian systems, including microgrids for resilient communities, drones for logistics and agriculture, and cybersecurity for critical infrastructure. This spillover opportunity is substantial but not yet systematically managed.

***E. Energy as a system integrator***
Because housing, healthcare, mobility, water, digital services, education and local economies depend on energy, it offers one of the strongest leverage points for connecting reconstruction to human needs. Warm homes, functioning hospitals, reliable water, resilient schools, safe communications and viable local economies all depend on energy continuity. Treating energy as a system integrator would therefore focus innovation on services and wellbeing rather than isolated technologies.

***F. District heating and thermal resilience as a flagship mission***
Ukraine's winter-resilience needs and extensive district-heating infrastructure complement Swedish strengths in district heating, heat pumps, storage integration, energy-system integration and municipal energy planning. A joint flagship mission could connect warm homes, resilient public buildings, thermal comfort, public health and long-term efficiency. It must also recognise that much infrastructure needs modernisation and that resilience measures require assessment for both service continuity and long-term decarbonisation.

***G. Water-energy resilience for essential services***
Reliable energy is critical to water, wastewater, sanitation, public health, emergency response and municipal operations. Documented Ukrainian examples in this report include solar-powered utilities, solar-plus-storage, pumping-station upgrades, efficient pumping and wastewater modernisation. These are site-level examples, not evidence of whole-network resilience, but they establish a specific research opportunity around protecting water-service continuity under disruption and generating knowledge for future resilient cities.

## 2.5.4 Threats

***A. War and physical destruction***
Continued war, infrastructure damage and operational disruption threaten sustained innovation across energy, transport, research, public institutions and local services, while uncertainty deters investors. This does not remove Ukraine's innovation potential, but it changes the operating conditions. Programmes must be designed for security risk, interrupted mobility, physical damage and institutional pressure rather than assuming stable delivery.

***B. Fragmentation of international support***
Multiple donors, programmes and bilateral initiatives risk creating duplication, inefficiency and competing administrative demands despite the value of international support. Without shared missions, coordinated funding, common evidence frameworks and clear links between local needs and international resources, support may produce many projects but too little cumulative system learning.

***C. Lock-in to outdated systems during reconstruction***
Pressure for rapid rebuilding could lock Ukraine into inefficient buildings, vulnerable centralised energy systems and outdated infrastructure models, making later transformation harder. The danger is not reconstruction itself but reconstruction that restores pre-war vulnerabilities. Short-term repair must therefore be connected to long-term standards for energy performance, affordability, resilience and human-centred design.

***D. Brain drain and institutional weakening***
Displacement of researchers, engineers, entrepreneurs and professionals can weaken universities, firms, local ecosystems and public institutions needed for future transformation. Diaspora engagement mitigates this threat only where structured contribution channels allow continued participation and prevent talent abroad from becoming progressively disconnected from Ukrainian scientific, entrepreneurial and public-sector capacity.

***E. Over-focus on competitiveness instead of wellbeing***
Exports, technology, startups and competitiveness are important but insufficient measures of innovation success. If these objectives dominate policy while warm homes, functioning services, affordable energy, health, mobility, housing quality, local economic participation and wellbeing remain secondary, gains in parts of the economy may not translate into stronger living standards, stability or long-term resilience.

***F. Governance and coordination risks***
Corruption risks, remaining procurement weaknesses despite ongoing improvements, uneven coordination and unclear ownership of cross-sector missions can undermine innovation, especially in energy, reconstruction and municipal systems. Because these areas span several sectors and institutions, trust, transparency, accountability and clear responsibility are needed to prevent promising initiatives from remaining isolated pilots rather than becoming scalable systems.

***G. Cyber-physical dependency risk***
Increasing reliance on digital platforms, data, AI, distributed control, interoperability and connected public infrastructure creates new cyber-physical dependencies and possible points of failure. Digital energy systems, registries, public-service platforms and control architectures should treat cybersecurity and resilience as design requirements under ongoing attack and stress.

### 2.5.5 SWOT-Identified Strategic Opportunities

The SWOT analysis shows that war, institutional constraints and brain drain limit an innovation system whose available capacity is heavily directed towards the existential threat created by Russia's invasion or towards established priorities such as digitalisation. It identifies four core energy research and innovation priorities, and wider-report evidence supports two additional cross-cutting priorities on diaspora brain circulation and Sweden-Ukraine mutual learning.

***Priority 1. Establish long-term mission portfolios***

Ukraine and its partners should create 10- to 15-year portfolios focused on system needs such as rebuilding cities and developing new city models. Combining research, innovation, deployment and infrastructure could support continuity, institutional memory, investment stability and stronger implementation routes beyond fragmented pilots.

***Priority 2. Redefine innovation success***

Success should be measured not only through energy supply, distribution and demand, startups, GDP and exports, but through healthy lives, comfortable homes and resilient access to essential needs. This broader definition would connect technical and economic performance to human needs, flourishing lives and the report's ambition of improved living standards.

***Priority 3. Build multilateral mission coalitions***

EU, Ukrainian and partner-country coalitions should share funding, governance and testbeds. Common missions, standards and evidence frameworks could coordinate international support, reduce duplication, increase scale and generate knowledge useful to Ukraine and wider Europe.

***Priority 4. Strengthen municipal innovation capacity***

Cities should co-design innovation rather than only implement it. Where security, local capacity and partner readiness allow, a distributed living-lab portfolio could enable comparison and shared learning across Kyiv's digital governance, system coordination and energy modernisation; Lviv's international, healthcare and startup links; Dnipro and Kharkiv's engineering, industrial and technical-education strengths; Odesa's logistics and port resilience; Vinnytsia's municipal innovation and governance; Ivano-Frankivsk's regional, digital and energy-resilience relevance; and Kherson's potential for resilience-oriented reconstruction under extreme conditions.

***Priority 5. Build diaspora innovation and brain-circulation channels***

Wider-report evidence supports treating the diaspora as part of Ukraine's innovation capacity rather than only as talent loss. Structured routes could include dual affiliations, joint research and innovation calls, entrepreneurship funds, mentorship and investor networks, and temporary-return or remote-collaboration mechanisms. A Sweden-Ukraine track could connect Ukrainian researchers, engineers, entrepreneurs and professionals in Sweden to reconstruction-focused collaboration.

***Priority 6. Structure Sweden-Ukraine collaboration as mutual learning***

Wider-report evidence supports collaboration based on complementary capabilities rather

than a one-directional donor-recipient model. Swedish actors contribute district heating, energy-system expertise and municipal innovation capacity; Ukrainian actors contribute engineering, rapid deployment and resilience experience under operational pressure. Joint work in resilient energy, district heating, municipal energy systems, healthcare and human-centred reconstruction could generate knowledge for both countries. Collaboration could then support Ukraine's recovery while investing in future European resilience and human-needs-driven innovation.

## 2.6. Conclusions: From Innovation Capacity to Innovation Delivery

Throughout this report, innovation is described from a systems perspective. It highlights the importance of governance, institutions, funding, digitalisation, human capital and collaboration. Together, these factors explain why some innovation systems are better able to generate new knowledge and technological development. An equally important question is how these capabilities are translated into implementation, international collaboration and long-term impact.

Experiences from projects supporting the internationalisation of research and technology infrastructures, including the Swedish TIraMISO project, highlight several common challenges. They show that strong research environments and advanced technical infrastructure are important but rarely sufficient on their own. Even organisations with internationally competitive expertise may struggle to establish international partnerships and industrial collaboration. The limiting factors are often organisational rather than technological.

These experiences show that successful international collaboration depends on more than technical excellence. It also requires clear value propositions, business and organisational maturity, international networks and market knowledge. Equally important are organisations and intermediary functions that can connect research environments with industry, identify collaboration opportunities and support organisations throughout the collaboration process.

These observations are relevant beyond the Swedish context. As Ukraine continues to strengthen its research and innovation system, investments in research, technology and infrastructure will remain essential. However, similar attention should also be given to the organisational capabilities that enable these assets to create long-term value. This includes coordination, international networking, commercialisation support and structures that help translate research into practical application.

This perspective complements the broader systems analysis presented in the report. Strong research and innovation environments provide an essential foundation, but their long-term impact depends on the ability to connect research with users, industry and international partners. Strengthening both technical and organisational capacity can improve the implementation of innovation, support long-term international collaboration and increase the overall impact of research and innovation investments.

# B: Collaboration:
# Innovation and impact

# 3. Ongoing research & innovation collaborations: EU

**Summary**
Chapter 3 examines expanded EU-Ukraine research and innovation cooperation since 2022 and its role in preserving scientific capacity, supporting reconstruction and integrating Ukraine into European systems. Its scope covers programme participation, institutional alignment, targeted support, sector partnerships, regional cooperation and reconstruction finance. Cooperation operates through a portfolio including Horizon Europe, the European Research Area and Rome Declaration coalition, MSCA4Ukraine, EIC and EIT support, Interreg, NDICI, digital and energy cooperation, and the Ukraine Facility.

The principal finding is that cooperation works best when Ukraine is integrated into established European frameworks rather than parallel structures. This enables faster scaling, stronger networks and better collaboration; preserves researcher mobility and institutional links; connects research to reconstruction; and recognises Ukraine as a contributor of digital, cybersecurity and resilience knowledge, test environments and deployable solutions. However, administrative complexity, compliance and co-financing, uneven participation, damaged infrastructure and disrupted mobility constrain involvement. Urgent recovery can also push out fundamental research, doctoral training, scientific infrastructure and frontier innovation, while numerous EU instruments risk creating fragmentation unless coordination improves.

**Conclusions for Energy Innovation**
For energy innovation, ENTSO-E grid synchronisation strengthened Ukraine's energy security and enabled cross-border electricity trade, while EU-supported activity addresses renewables, grid modernisation, decentralised systems and resilience. Future cooperation could generate wider European knowledge on energy resilience and align rebuilding with climate-neutral, digital and sustainable infrastructure.

**Strategic opportunities and next steps**
1. Deepen Ukraine’s integration into the European Research Area.
2. Develop Ukraine as a frontline environment for resilience, security and system-transformation learning.
3. Scale innovation ecosystems through European markets, capital and partnerships.
4. Align reconstruction with Europe’s green and digital transitions.
5. Connect short-term recovery with long-term accession, institutional reform and capacity-building.
6. Prioritise coordination, wider participation and alignment with long-term research excellence, with less emphasis on creating new instruments.

**Chapter Structure**
Section 3.1 maps the principal programmes, institutions, instruments and sectors.
Section 3.2 draws four lessons from cooperation to-date.
Section 3.3 identifies five challenges affecting participation and continuity.
Section 3.4 sets out five opportunities and the priorities for the next phase.

## 3.1. EU– Ukraine research and innovation cooperation

Research and innovation cooperation between Ukraine and the European Union has expanded significantly since 2022 and now constitutes one of the most comprehensive external support frameworks for Ukraine's scientific system, innovation capacity, and long-term reconstruction. The EU approach is characterised by a combination of programme integration, institutional alignment, targeted support instruments, and sector-specific partnerships, rather than a single overarching initiative.[67]

A central pillar of EU–Ukraine cooperation is Ukraine's association to Horizon Europe, which provides Ukrainian researchers, universities, and companies with access to one of the world's largest research and innovation funding programmes. Since 2022, the European Commission has introduced facilitation measures, including financial guarantees, flexibility for disrupted projects, and targeted support for Ukrainian participation.[68] Ukrainian entities are increasingly involved in collaborative projects across areas such as climate, digital technologies, health, security, and energy systems.[69]

In parallel, the EU has intensified efforts to integrate Ukraine into the European Research Area (ERA). The *Rome Declaration on Science, Research and Innovation in Ukraine*, adopted in 2025, established a coalition of EU Member States and partners committed to supporting Ukraine's research ecosystem, infrastructure rebuilding, and institutional reform.[70] The initiative emphasises long-term system integration, including alignment with EU research governance, open science principles, and research infrastructure networks.

The EU has also developed targeted instruments to address the disruption of Ukraine's research system. The MSCA4Ukraine programme, funded under the Marie Skłodowska-Curie Actions, provides fellowships for displaced Ukrainian researchers to continue research in European institutions while maintaining connections with Ukrainian academia.[71] This has been critical for preserving scientific capacity and preventing long-term talent loss.

Support for innovation and entrepreneurship is delivered through mechanisms such as the European Innovation Council (EIC) and the European Institute of Innovation and Technology (EIT). The EIC has extended funding and mentoring to Ukrainian startups, while the EIT

67 European Commission. (n.d.). *European Research Area Policy Agenda 2025-2027.* https://european-research-area.ec.europa.eu/era-policy-agenda-2025-2027

68 European Commission. (2022). *Ukraine's association agreement to Horizon Europe and Euratom Research and Training Programmes enters into force.* https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/ukraines-association-agreement-horizon-europe-and-euratom-research-and-training-programmes-enters-2022-06-09_en

69 European Commission. (n.d.). *EU Funded projects.* https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/projects-results

70 European Commission. (2025*). International coalition for science, research and innovation in Ukraine.* https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/europe-world/international-cooperation/association-horizon-europe/international-coalition-science-research-and-innovation-ukraine_en

71 European Commission. (2022). *MSCA4Ukraine.* https://cordis.europa.eu/project/id/101101923

Community Hub Ukraine facilitates integration into European innovation networks and supports sectors such as energy, digitalisation, climate, and manufacturing.[72,73]

Digitalisation is another key domain of cooperation. The EU has supported Ukraine's digital transformation and interoperability, including alignment with EU digital standards, cybersecurity collaboration, and e-governance development.[74] Ukraine's advanced digital public infrastructure has also made it an important partner for testing and scaling digital solutions in areas such as identity systems, public services, and resilience under crisis conditions.

Energy cooperation has become increasingly strategic. Ukraine's electricity grid was synchronised with the ENTSO-E European network in 2022, strengthening energy security and enabling cross-border electricity trade.[75] In addition, EU-funded initiatives support renewable energy deployment, grid modernisation, and decentralised energy solutions, often linked to reconstruction and resilience goals.[76]

At the regional level, Interreg and NDICI programmes support cross-border and regional cooperation, including innovation ecosystems, environmental projects, infrastructure development, and governance capacity. These initiatives help connect Ukrainian regions with EU counterparts and facilitate knowledge exchange at the subnational level.

The EU has also introduced large-scale financial instruments such as the Ukraine Facility (2024–2027), which includes components related to research, innovation, digitalisation, and industrial development. This facility aligns reconstruction funding with EU accession processes and provides a framework for integrating innovation into broader economic and institutional reform.[77]

Taken together, EU–Ukraine research and innovation collaboration can be categorised into:

- EU programme participation (Horizon Europe, MSCA, EIC, EIT)
- Institutional integration (ERA, Rome Declaration coalition)
- Targeted support instruments (MSCA4Ukraine, EIT Hub Ukraine)
- Sectoral partnerships (energy, digitalisation, cybersecurity, climate)
- Regional and cross-border cooperation (Interreg, NDICI)
- Reconstruction-linked funding frameworks (Ukraine Facility)

72 European Innovation Council. (2023). *The EIC €20 million Ukrainian tech call and other initiatives to support Ukraine*. https://eic.ec.europa.eu/news/eic-eu20-million-ukrainian-tech-call-and-other-initiatives-support-ukraine-2023-02-24_en

73 European Institute of Innovation and Technology. (2023). *EIT Community Hub Ukraine.* https://www.eit.europa.eu/news-events/news/new-innovation-hub-opens-ukraine-eit-continues-strengthen-support-ukrainian

74 European Commission. (n.d.). *Supporting Ukraine through digital* https://digital-strategy.ec.europa.eu/en/policies/support-ukraine

75 ENTSO-E. (2022). *Continental Europe successful synchronisation with Ukraine and Moldova power systems*. https://www.entsoe.eu/news/2022/03/16/continental-europe-successful-synchronisation-with-ukraine-and-moldova-power-systems/

76 European Investment Bank. (2023). EIB approves "EU for Ukraine" Initiative to finance Ukraine recovery and reconstruction, and backs transport, energy and business investment around the world. https://www.eib.org/en/press/all/2023-157-eib-approves-eu-for-ukraine-initiative-to-finance-ukraine-recovery-and-reconstruction-and-backs-transport-energy-and-business-investment-around-the-world

77 European Commission. (2024). *Ukraine Facility.* https://enlargement.ec.europa.eu/funding-technical-assistance/ukraine-facility_en

The table below shows a list of selected research and innovation initiatives.

**Table B3.1. Selected EU-Ukrainian Research and Innovation Initiatives**

| Initiative | EU actor(s) | Ukrainian partner(s) / focus | Type | Main theme | Timeframe / status |
|---|---|---|---|---|---|
| **Horizon Europe participation** | European Commission | Ukrainian universities, research institutes, SMEs | EU framework programme | Research, innovation, EU integration | Ongoing (since 2021, expanded after 2022) |
| **Rome Declaration Coalition** | European Commission, EU Member States | Ukrainian research and innovation system | Intergovernmental framework | ERA integration, research system reconstruction | Launched 2025 |
| **MSCA4Ukraine** | European Commission (MSCA) | Displaced Ukrainian researchers, universities | Fellowship programme | Research mobility, capacity preservation | Ongoing (since 2022) |
| **European Innovation Council (EIC) support** | European Commission (EIC) | Ukrainian startups and SMEs | Innovation funding programme | Deep tech, startups, scaling | Ongoing |
| **EIT Community Hub Ukraine** | European Institute of Innovation and Technology | Ukrainian innovation ecosystem actors | Innovation network hub | Innovation ecosystems, entrepreneurship | Ongoing (launched 2023) |
| **ENTSO-E grid synchronisation** | ENTSO-E, European Commission | Ukrainian energy system operators | Infrastructure integration | Energy resilience, electricity markets | Completed 2022, ongoing integration |
| **EU energy resilience projects** | European Commission, EIB, EBRD | Ukrainian municipalities, energy actors | Investment and project funding | Energy systems, decentralisation, resilience | Ongoing |
| **Digital cooperation initiatives** | European Commission | Ministry of Digital Transformation of Ukraine | Policy and technical cooperation | Digitalisation, interoperability, cybersecurity | Ongoing |
| **Interreg cross-border programmes** | European Commission | Ukrainian regional authorities | Regional cooperation programme | Innovation, environment, infrastructure | Ongoing |
| **NDICI (Neighbourhood Instrument)** | European Commission | Ukrainian public institutions and regions | Development cooperation instrument | Governance, infrastructure, innovation | Ongoing |
| **Ukraine Facility (2024–2027)** | European Commission | Ukrainian government and institutions | Macro-financial and reform instrument | Reconstruction, innovation, EU accession | 2024–2027 |
| **EBRD innovation and SME support** | EBRD (EU-aligned) | Ukrainian SMEs and startups | Financial and advisory programme | Private sector development, innovation | Ongoing |
| **Digital Europe Programme (select access)** | European Commission | Ukrainian digital and research actors | EU digital programme | AI, HPC, cybersecurity | Expanding participation |

## 3.2. Lessons learnt: EU–Ukraine

A first lesson is that research and innovation cooperation between the EU and Ukraine works most effectively when it is embedded within existing European frameworks rather than built as parallel systems. Ukraine's participation in Horizon Europe, integration into the European Research Area, and access to instruments such as MSCA and the EIC demonstrate that alignment with established programmes enables faster scaling, stronger networks, and higher-quality collaboration.

A second lesson is that linking research and innovation to reconstruction and system transformation is essential. Many of the most impactful EU-supported initiatives combine research with practical applications in areas such as energy resilience, digital governance, infrastructure recovery, and health systems. This reflects a shift from research as an isolated activity toward research as part of broader societal and economic rebuilding.

A third lesson is that mobility and continuity mechanisms are critical under crisis conditions. Programmes such as MSCA4Ukraine have shown that maintaining researcher mobility, institutional links, and access to European networks helps preserve Ukraine's scientific capacity and reduces the risk of long-term talent loss.

A fourth lesson is that Ukraine is not only a beneficiary but also a contributor to innovation. In areas such as digital public services, cybersecurity, and resilience under extreme conditions, Ukrainian institutions and companies provide valuable knowledge, real-world testing environments, and rapidly deployable solutions that are relevant beyond Ukraine.

## 3.3. Challenges: EU–Ukraine

The most significant challenge is administrative and institutional complexity. EU research and innovation programmes, particularly Horizon Europe, involve demanding application processes, compliance requirements, and co-financing structures. For Ukrainian institutions operating under wartime conditions, these requirements can limit participation, especially for smaller organisations.

A second challenge is uneven participation capacity across the Ukrainian system. Leading universities, research institutes, and innovation actors are increasingly integrated into EU networks, but many regional institutions and smaller organisations face barriers related to resources, administrative capacity, and access to partnerships.

A third challenge is the operational impact of war on infrastructure and institutions. Damage to laboratories, universities, and energy systems, as well as disruptions to mobility and daily operations, affects the continuity and scale of research collaboration. Even well-designed EU programmes must operate within an environment of uncertainty and risk.

A fourth challenge concerns the balance between short-term reconstruction needs and long-term research capacity. EU funding has necessarily prioritised urgent recovery, resilience, and infrastructure projects. While this is essential, there is a risk that fundamental research, doctoral training, advanced scientific infrastructure, and frontier innovation receive comparatively less attention.

A fifth challenge is that EU–Ukraine cooperation spans multiple policy domains, including research, innovation, development, enlargement, energy, and security. While this creates opportunities for synergies, it can also lead to fragmentation and unclear prioritisation unless coordination across instruments and institutions is strengthened.

## 3.4. Opportunities: EU–Ukraine

The most important opportunity is to advance toward deep integration of Ukraine into the European Research Area and innovation system. Current participation in EU programmes provides a strong foundation for long-term structural integration, including alignment with EU standards, governance models, and research infrastructures.

A second opportunity is to position Ukraine as a frontline innovation environment for resilience, security, and system transformation. EU–Ukraine collaboration can generate globally relevant knowledge in areas such as energy resilience, digital governance, cybersecurity, defence-related innovation, and crisis response. These are domains of increasing strategic importance for Europe as a whole.

A third opportunity lies in scaling innovation ecosystems and strengthening startup collaboration. Through instruments such as the European Innovation Council and EIT networks, Ukrainian startups can access European markets, capital, and partnerships, while contributing high-level technical talent and innovative solutions.

A fourth opportunity is to align reconstruction with the European green and digital transitions. EU frameworks provide a pathway to rebuild Ukraine's infrastructure, industry, and public systems in line with long-term sustainability, climate neutrality, and digitalisation goals, creating a model for integrated transformation.

A fifth opportunity is to use EU–Ukraine cooperation as a bridge between short-term recovery and long-term accession and integration processes. Research and innovation collaboration can support institutional reform, governance alignment, and capacity-building, thereby contributing to Ukraine's broader integration into the European Union.

Overall, the evidence suggests that EU–Ukraine cooperation has already evolved into a system-level partnership. The next phase is less about creating new instruments and more about improving coordination, expanding participation, and ensuring that short-term reconstruction efforts are aligned with long-term research excellence and innovation capacity.

# 4. Ongoing research & innovation collaborations: Ukraine-Sweden

**Summary**
Chapter 4 examines Swedish-Ukrainian research and innovation cooperation. It covers policy, reconstruction, universities, applied innovation, skills and sector projects. Cooperation has become more structured since 2022 but remains a linked portfolio rather than one umbrella partnership.

Examples include the SI programme; Sweden's membership of the Coalition for Science, Research and Innovation; innovation and digitalisation cooperation; a defence letter aspiring to a bilateral Defence Innovation Hub; Sweden's announced doubling of its innovation initiative to SEK 300 million, with anti-drone and other technologies under review; university partnerships; preparatory WIRNU; announced Beetroot skills support; UA-GRIDEX; and food-system research.

Four lessons emerge. Cooperation works best when linked to societal needs; flexible programmes combine continuity with wartime responsiveness; innovation cannot be separated from reconstruction and resilience; and durable cooperation depends on human capital, trust, networks and institutions as well as funding and technology.

The challenges are fragmentation, wartime disruption, tension between urgent support and long-term research capacity, and competing humanitarian, developmental, academic, technological and defence logics.

**Conclusions for Energy Innovation**
For energy innovation, the portfolio combines planning, decentralisation and wartime resilience. Through local capacity-building and risk mitigation, UA-GRIDEX aims to help Ukrainian energy planners modernise infrastructure and improve resilience, sustainability and efficiency. Energy illustrates cooperation linked to reconstruction, essential infrastructure and lasting local capacity under wartime conditions. The chapter suggests stronger coordination.

**Strategic Opportunities and Next Steps**
1. Organise existing initiatives into a coherent Swedish-Ukrainian partnership portfolio.
2. Treat Ukraine as a co-creator under extreme conditions, not only a recipient.
3. Connect Swedish capabilities and Ukrainian needs systematically.
4. Use bilateral cooperation as a bridge to durable European research integration.
5. Connect, scale and strategically align existing collaborations rather than inventing cooperation from scratch.

**Chapter Structure**
Section 4.1 maps five cooperation categories.
Sections 4.2-4.4 present four lessons, four challenges, four opportunities and the next-phase direction.

## 4.1. Sweden–Ukraine research and innovation cooperation

Sweden's research and innovation cooperation with Ukraine has become more structured since 2022 and now spans system-level policy frameworks, university partnerships, applied innovation projects, capacity-building efforts, and sector-specific initiatives. Rather than one single umbrella partnership, the current landscape consists of a growing portfolio of linked initiatives focused on reconstruction, reform, EU integration, digitalisation, resilience, and innovation capacity.[78,79,81,82,83]

One of the most important Swedish frameworks is the SI Ukraine Cooperation Programme, administered by the Swedish Institute. The programme supports Swedish actors working with Ukrainian partners on projects that contribute to Ukraine's reconstruction, reform efforts, and EU integration. Recent calls have specifically emphasised innovation ecosystems, transparency and anti-corruption, and gender equality.[79] The Swedish Institute has also reported that the programme supported 41 projects in one major round, with a total funding envelope of SEK 56 million, covering areas such as ICT, entrepreneurship, transport, urban and rural development, food systems, cultural heritage, and rehabilitation.[80]

At the intergovernmental level, Sweden has become more active in institutional cooperation on research and innovation with Ukraine. In July 2025, Sweden became a founding member of the Coalition for Science, Research and Innovation in Ukraine, launched through the Rome Declaration. The coalition aims to support the reconstruction and modernisation of Ukraine's science and research ecosystem, including through joint research projects and closer integration into the European Research Area.[81] In November 2025, Sweden and Ukraine also signed a letter of intent on enhanced innovation and digitalisation cooperation, marking a further step toward formalised bilateral innovation collaboration.[82]

A parallel track has emerged in defence-related innovation. Sweden and Ukraine signed a letter of intent concerning a Defence Innovation Partnership in November 2025, with the stated ambition of deepening cooperation between Swedish and Ukrainian defence innovation and industrial ecosystems, including the establishment of a Swedish-Ukrainian Defence Innovation Hub in Ukraine.[83] In addition, the Swedish Government later announced

78 Government Offices of Sweden. (2025). *Government doubles innovation initiative for Ukraine to SEK 300 million.* https://www.government.se/press-releases/2025/09/government-doubles-innovation-initiative-for-ukraine-to-sek-300-million/

79 Swedish Institute. (2026). *SI Ukraine Cooperation Programme.* https://si.se/en/apply/funding-grants/si-ukraine-cooperation-programme-2/

80 Swedish Institute. (2024). *The Swedish Institute supports 41 projects in new major initiative for Ukraine.* https://si.se/en/the-swedish-institute-supports-41-projects-in-new-major-initiative-for-ukraine/
Swedish Institute. (2026). *Projects granted funding: SI Ukraine Cooperation Programme.* https://si.se/en/projects-granted-funding/programmes/si-ukraine-cooperation-programme/

81 Government Offices of Sweden. (2025). *Sweden is a founding member of the initiative Coalition for Science, Research and Innovation in Ukraine.* https://www.government.se/press-releases/2025/07/sweden-is-a-founding-member-of-the-initiative-coalition-for-science-research-and-innovation-in-ukraine/

82 Government Offices of Sweden. (2025). *Sweden and Ukraine deepen innovation and digitalisation cooperation.* https://www.government.se/press-releases/2025/11/sweden-and-ukraine-deepen-innovation-cooperation1/

83 Government Offices of Sweden. (2025). *Letter of Intent between Sweden and Ukraine concerning Defence Innovation Partnership.* https://www.government.se/swedish-treaty-series/2025/11/letter-of-intent-between-sweden-and-ukraine-concerning-defence-innovation-partnership/

that it was doubling its innovation initiative for Ukraine to SEK 300 million, with Swedish and Ukrainian experts reviewing technologies including anti-drone systems for further development and production. This is not conventional academic research cooperation, but it is clearly part of the broader Swedish-Ukrainian innovation landscape.

At the university level, several Swedish institutions have established more direct cooperation structures. Lund University has developed the Lund-Ukraine Alliance for Academic Support (LUA), a network intended to help Ukrainian academia continue developing education and research despite the war. LUA describes its role as identifying needs, promoting support to Ukrainian academic communities, and building effective collaborations. It has also reported that new cooperation agreements have been signed between faculties at Lund University and Ukrainian universities.[84]

Another Lund-based actor, the Raoul Wallenberg Institute (RWI), is engaged in Ukraine through the programme Human Rights Infrastructure for Ukraine 2025–2027, funded by Sida. The programme aims to support Ukraine's recovery and EU accession by strengthening human rights infrastructure at national and local levels.[85] While this is not "innovation" in a narrow technological sense, it is an important example of Swedish-Ukrainian research, institutional development, and knowledge cooperation linked to governance and societal resilience.

Within AI and applied digital innovation, AI Sweden participates in Women's Innovation & Resilience Network – Ukraine (WIRNU), a preparatory project financed by the Swedish Institute. According to AI Sweden, the initiative combines Swedish expertise in applied AI, responsible innovation, and ethical frameworks with the Ukrainian organisation Impact Force's work on social change and economic opportunities for vulnerable groups.[86] This makes WIRNU a concrete example of Swedish-Ukrainian collaboration at the intersection of AI competence, reconstruction, and inclusive innovation.

Sweden also supports Ukrainian digital capacity-building more broadly. In July 2025, the Swedish Government announced support of almost SEK 10 million to Beetroot Academy, with the aim of helping more than 2,000 professionals in Ukraine's public administration, civil society, and IT sector strengthen their digital skills.[87] Although this is primarily a skills and innovation-system intervention rather than a research project, it is highly relevant for long-term innovation collaboration because it strengthens the human capital base on which research, entrepreneurship, and digital transformation depend.

There are also topic-specific academic collaborations. Örebro University is running a research project on the digitalisation of the Ukrainian tax administration, using the OECD's

84 Lund-Ukraine Alliance for Academic Support. (n.d.). *About.* https://lua.blogg.lu.se/about/
Lund-Ukraine Alliance for Academic Support. (2025). *Update from LUA (June–November 2025).*
https://lua.blogg.lu.se/2025/12/01/update-from-lua-june-november-2025/
85 Raoul Wallenberg Institute. (2026). *Our work in Ukraine.* https://rwi.lu.se/ukraine/
86 AI Sweden. (n.d.). *WIRNU – AI-kompetens för Ukrainas återuppbyggnad.*
https://www.ai.se/sv/projekt/wirnu-ai-kompetens-ukrainas-ateruppbyggnad
87 Government Offices of Sweden. (2025). *New Swedish support strengthens Ukraine's IT expertise.*
https://www.government.se/press-releases/2025/07/new-swedish-support-strengthens-ukraines-it-expertise/

Tax Administration 3.0 framework and comparing Swedish and Ukrainian tax systems.[88] This is a clear example of a focused Swedish-Ukrainian research collaboration related to digital governance, public administration reform, and law and AI-adjacent digitalisation.

Linköping University is involved in several Ukraine-related collaborations. One example is a study, developed together with Ukrainian partners including Dnipro University of Technology, on how Ukraine has maintained public services during wartime; Linköping University notes that the work has been funded by the Swedish Research Council and the Swedish Institute.[89] Linköping is also involved in the SI-supported STREAM-U initiative, which focuses on service transformation, resilience, and local governance in Ukraine.[90] Through Barnafrid, Linköping University also participates in the project Training Programme to End Violence Against Children in Ukraine, carried out with the Ukrainian Catholic University in Lviv during 2024–2026.[91] Together, these projects show that Swedish-Ukrainian collaboration is not limited to technology fields, but also includes governance, public services, and social system innovation.

Umeå University has developed collaborations with Ukrainian higher education institutions through Erasmus+ and related academic partnerships. Umeå reports cooperation with Odesa Mechnikov National University, Kharkiv Karazin National University, and Vinnytsia National Pirogov Medical University, with a focus on life sciences, chemistry, and biomedicine.[92] This is significant because it shows that Ukrainian-Swedish cooperation also includes mobility, laboratory-oriented disciplines, and long-term scientific relationship-building beyond immediate reconstruction topics.

In the energy field, the Swedish Institute has highlighted projects designed to strengthen Ukraine's energy infrastructure and local energy resilience. One example is UA-GRIDEX: Ukraine's Grid Resilience and Infrastructure Development Excellence, which aims to help Ukrainian energy planners modernise infrastructure, improve resilience, and promote sustainability and energy efficiency, with a strong focus on local capacity-building and risk mitigation.[93] These projects show that Ukrainian-Swedish cooperation in energy increasingly combines technical planning, decentralisation, and resilience under wartime conditions.

There are also collaborations in food systems and preparedness. In 2026, SLU launched the research project SFSC4SEC, which examines how short food supply chains can strengthen

88 Örebro University. (n.d.). *Digitalising Tax Administration: Insights from Ukraine for a Resilient Future.* https://www.oru.se/english/research/research-projects/rp/?rdb=p2766

89 Linköping University. (2025). *How Ukraine keeps society going despite the war.* https://liu.se/en/news-item/how-ukraine-keeps-society-going-despite-the-war

90 Linköping University. (n.d.). *Service transformation, resilience, and empowerment through active municipalities in Ukraine (STREAM-U).* https://liu.se/en/research/stream-u

91 Linköping University, Barnafrid. (n.d.). *Exchange of knowledge in support of Ukraine's children and youth.* https://liu.se/en/research/barnafrid/knowledge-exchange-in-support-of-ukraine-s-children-and-youth

92 Umeå University. (2024). *Building bridges through Erasmus+: Umeå University's collaboration with Ukraine and Moldova.* https://www.umu.se/en/feature/building-bridges-through-erasmus/

93 Swedish Institute. (n.d.). *UA-GRIDEX: Ukraine's Grid Resilience and Infrastructure Development Excellence.* https://si.se/en/projects-granted-funding/ua-gridex-ukraines-grid-resilience-and-infrastructure-development-excellence/ Swedish Institute. (2024). *Building resilience: Swedish Institute funds project to support Ukraine's energy infrastructure.* https://si.se/en/building-resilience-swedish-institute-funds-project-to-support-ukraines-energy-infrastructure/

preparedness in times of crisis, drawing in part on experience from Ukraine.[94] This reflects a growing type of Ukrainian-Swedish cooperation where research is framed around resilience, food security, local production systems, and societal preparedness, rather than only around conventional R&D commercialisation.

Taken together, the current Ukrainian-Swedish collaboration landscape can be grouped into five broad categories:

1. strategic and intergovernmental frameworks,
2. programme-based reconstruction and reform cooperation,
3. university and academic support networks,
4. applied innovation and digital competence initiatives, and
5. sector-specific collaborative projects in governance, energy, food systems, social services, and resilience.

**Table B4.1. Selected Ukrainian-Swedish Research and Innovation Initiatives**

| Initiative | Swedish actor(s) | Ukrainian partner(s) / focus | Type | Main theme | Timeframe / status |
|---|---|---|---|---|---|
| **Coalition for Science, Research and Innovation in Ukraine** | Government of Sweden | International coalition supporting Ukraine's research and innovation ecosystem | Intergovernmental framework | Science, research, innovation policy, ERA integration | Launched 2025 |
| **SI Ukraine Cooperation Programme** | Swedish Institute | Multiple Ukrainian partners | Funding programme | Reconstruction, reform, EU integration, innovation ecosystems | Ongoing |
| **Sweden-Ukraine innovation and digitalisation cooperation** | Government of Sweden | Ministry of Digital Transformation of Ukraine | Bilateral policy initiative | Innovation, digitalisation | Letter of intent signed 2025 |
| **Defence Innovation Partnership** | Government of Sweden / defence actors | Ukrainian defence innovation ecosystem | Bilateral innovation initiative | Defence innovation, industrial ecosystems | Signed 2025, funding expanded |
| **Lund-Ukraine Alliance for Academic Support (LUA)** | Lund University | Ukrainian universities | Academic support network | Higher education, research cooperation | Ongoing |
| **Human Rights Infrastructure for Ukraine** | Raoul Wallenberg Institute | Ukrainian national and local institutions | Institutional knowledge programme | Human rights, governance, EU accession support | 2025–2027 |
| **WIRNU** | AI Sweden | Impact Force and broader Ukrainian | Applied innovation project | AI, responsible innovation, | Ongoing |

94 Swedish University of Agricultural Sciences. (2026). *The war in Ukraine shows that short food supply chains secure food in times of crisis.* https://www.slu.se/en/news/2026/04/the-war-in-ukraine-shows-that-short-food-supply-chains-secure-food-in-times-of-crisis/

| | | | | | |
|---|---|---|---|---|---|
| | | stakeholder network | | inclusion, reconstruction | |
| **Beetroot Academy support** | Swedish Government | Beetroot Academy / Ukrainian professionals | Capacity-building initiative | Digital skills, IT competence | Announced 2025 |
| **Digitalising Tax Administration** | Örebro University | Ukrainian tax-administration research focus | Research project | Digital governance, tax administration, comparative law | Ongoing |
| **Public-services resilience research** | Linköping University | Dnipro University of Technology and partners | Research project | Governance, resilience, public services | Ongoing |
| **STREAM-U** | Linköping University and partners | Ukrainian local-governance stakeholders | Collaborative reform project | Service transformation, resilience, local governance | Ongoing |
| **Training Programme to End Violence Against Children in Ukraine** | Linköping University / Barnafrid | Ukrainian Catholic University, Lviv | Capacity-building / knowledge-exchange project | Child protection, social services, reform | 2024–2026 |
| **Erasmus+ cooperation with Ukrainian universities** | Umeå University | Odesa, Kharkiv, Vinnytsia partner universities | Academic mobility and cooperation | Life sciences, chemistry, biomedicine | Ongoing |
| **UA-GRIDEX** | Swedish actors supported by SI | Ukrainian municipal and energy-planning partners | Applied resilience project | Energy infrastructure, decentralisation, resilience | Ongoing |
| **Swedish Institute energy-resilience projects** | Swedish Institute-supported partners | Ukrainian local energy actors | Applied innovation / resilience support | Energy infrastructure and local resilience | Ongoing |
| **SFSC4SEC** | SLU | Ukraine-related food-system research context and partners | Research project | Food security, preparedness, short supply chains | Launched 2026 |

## 4.2. Lessons learnt: Ukraine–Sweden

A first lesson is that research and innovation cooperation with Ukraine works best when it is linked to concrete societal needs, rather than built only around abstract academic exchange. Many of the strongest examples combine research, innovation, and implementation in areas such as public services, energy resilience, child protection, digital administration, and food security.

A second lesson is that institutional flexibility matters. Swedish actors have often supported Ukraine through programme-based models, modular partnerships, and capacity-building networks rather than through rigid long-term structures alone. This has made it possible to combine continuity with responsiveness under wartime conditions.

A third lesson is that innovation cooperation in Ukraine cannot be separated from reconstruction and resilience. In the Ukrainian context, innovation is frequently about maintaining essential services, protecting infrastructure, preserving institutional capacity, and building future readiness under pressure. Swedish cooperation has increasingly adapted to this reality.

A fourth lesson is that human capital is as important as technology. Initiatives such as Beetroot Academy, LUA, Erasmus+, AI Sweden's WIRNU, and governance-related training programmes suggest that durable cooperation depends on skills, networks, trust, and institutional relationships, not only on funding or hardware.

## 4.3. Challenges: Ukraine–Sweden

The most obvious challenge is fragmentation. There are many valuable initiatives, but they are spread across ministries, universities, institutes, and programmes. This creates a rich ecosystem, but it also means that Sweden's overall engagement can appear dispersed rather than strategically integrated.

A second challenge is the operational reality of war. Security conditions, damaged infrastructure, disrupted mobility, and pressure on Ukrainian institutions affect the continuity, scale, and pace of collaboration. Even well-designed projects must function in an environment of uncertainty.

A third challenge concerns the balance between short-term support and long-term institution-building. Many projects respond to urgent reconstruction or resilience needs, which is necessary, but there is also a risk that structural research cooperation, doctoral training, laboratory development, and frontier innovation receive less attention than immediate capacity support.

A fourth challenge is that cooperation often spans different logics: humanitarian, developmental, academic, technological, and defence related. These can reinforce one another, but they can also lead to unclear priorities unless there is stronger strategic coordination.

## 4.4. Opportunities: Ukraine-Sweden

The most important opportunity is to move from fragmented initiatives toward a more clearly articulated Ukrainian-Swedish research and innovation partnership portfolio. The existing base is already substantial enough to support stronger coordination across energy, digitalisation, governance, life sciences, AI, resilience, and industrial innovation.

A second opportunity is to position Ukraine not only as a recipient of support, but as a co-creator of innovation under extreme conditions. Several current collaborations already reflect this shift, especially in digital governance, resilience, public services, and defence-related innovation.

A third opportunity lies in connecting Swedish strengths more systematically to Ukrainian needs. Sweden has strong capabilities in digital government, energy systems, sustainability, public administration, life sciences, AI, and collaborative innovation policy, while Ukraine offers urgent use cases, highly capable technical communities, and growing integration with European frameworks.

A fourth opportunity is to use current cooperation as a bridge into longer-term European research integration. The coalition launched in Rome, the SI programme, and the growing number of university-level partnerships all suggest that Ukrainian-Swedish cooperation can evolve from reconstruction support into durable collaboration within the wider European research and innovation system.

Overall, the evidence suggests that Sweden and Ukraine already have a meaningful base of collaboration. The next step is less about inventing cooperation from scratch and more about connecting, scaling, and strategically aligning the collaborations that already exist.

# C. Resilient energy systems, energy research, and innovation needs in Ukraine

# 5. Energy research & innovation, priorities and needs

**Summary**
Chapter 5 translates converging Ukrainian and EU energy priorities into research needs for reconstruction, EU integration and possible Swedish cooperation. War, accession and climate transition require more than restoring the pre-war system. Energy should become a core innovation arena and daily-life system. Six priorities converge: security/resilience; distributed energy; efficient buildings; renewables, storage and flexibility; EU-aligned markets/governance; and a just transition focused on energy poverty, health, comfort and vulnerable groups.

**Conclusions for Energy Innovation**
Research should connect resilience, decarbonisation, affordability, reform and human outcomes. Relevant fields are distributed systems that fail gracefully and recover rapidly; energy-positive reconstruction; heat resilience; digital energy, AI and cybersecurity; industrial/supply-chain innovation; and mission-oriented governance.

**Recommendations and Proposed Directions**

1. **Proposed direction:** Move beyond damaged conventional infrastructure through renewables, storage and balancing, geographic and prosumer reform, domestic equipment, market liberalisation, affordability protection, EU alignment and decarbonisation.
2. **Research priorities:** Study critical-service microgrids and cyber-secure controls; deep renovation, heat pumps, district systems, passive survivability and lifecycle procurement; low-temperature heat, waste heat, storage and hybrids, with municipal utilities a central part; and digital twins, AI forecasting, secure data exchange and cybersecurity assessed against service continuity and human outcomes.
3. **Industrial opportunity:** Address the outdated, energy-intensive industrial base. Renewable expansion could reduce import dependence and emissions if policy, grid access, affordability, investment and reliable equipment enable it. Identify domestic or EU-partner value chains and potential global supply of resilience solutions.
4. **Research and policy challenge:** Energy currently lacks a coordinating mechanism. Design governance, procurement and financing models aligning municipalities, utilities, start-ups, universities and donors around resilient hospitals, energy-secure communities and efficient housing.

**Chapter Structure**
Section 5.1 sets out six converging EU-Ukrainian policy priorities.
Section 5.2 translates them into six research and innovation needs.

## 5.1. EU and Ukrainian energy research & innovation priorities

Energy should be treated as one of the core innovation arenas for Ukraine, not only as an infrastructure sector. This report already identifies energy as a critical gap and opportunity in the WINWIN strategy: energy is linked to infrastructure, decarbonisation, EU alignment and technology deployment, but is not yet consistently framed as a daily-life system that delivers warm homes, affordable services, resilient hospitals, functioning schools and viable communities.

Ukraine's energy system is being reshaped by three forces at once: wartime destruction, EU accession, and the long-term shift to a climate-neutral economy. Russian attacks have made energy resilience a matter of survival, while EU accession turns energy market reform, climate policy, energy efficiency and regulatory alignment into strategic requirements. At the same time, *Ukraine's Energy Strategy to 2050* and *National Energy and Climate Plan (NECP) 2025–2030* create a framework for decarbonisation, renewable energy, energy efficiency, market integration and security of supply.[95,96,97]

This creates an unusual research and innovation challenge. Ukraine cannot simply rebuild the pre-war electricity system. Academic work on Ukraine's power sector reaches a similar conclusion: the war exposed the vulnerability of highly concentrated energy assets, while the pre-war system was already too inflexible to absorb further renewable generation without storage, balancing capacity and market reform. Kurbatova et al. argue that post-war reconstruction should move beyond restoring damaged conventional infrastructure and instead combine renewable deployment, storage and balancing capacity, better geographic planning, household net-billing/prosumer reforms, domestic equipment production, market liberalisation, EU energy-market alignment, affordability protections and long-term decarbonisation.[98]

The strongest policy signals from Ukraine and the EU point to six overlapping priorities. These should be read together as a coherent transformation agenda rather than as isolated workstreams.

First, energy security and resilience remain fundamental. The EU accession process and Ukraine's own energy policy emphasise security of supply, infrastructure protection, emergency preparedness and integration with European energy systems. The synchronisation with ENTSO-E in 2022 created a strategic foundation, but the war has

95 Cabinet of Ministers of Ukraine. (2023). *Ukraine is an energy hub in Europe. Government approves Energy Strategy until 2050.* Ministry of Energy of Ukraine. [Translated] https://mev.gov.ua/novyna/ukrayina-enerhetychnyy-khab-yevropy-uryad-skhvalyv-enerhetychnu-stratehiyu-do-2050-roku

96 Ministry of Economy of Ukraine. (2024). *National Energy and Climate Plan of Ukraine 2025–2030.* Government of Ukraine. https://me.gov.ua/Documents/Detail?lang=en-GB&id=d3c7185c-8669-4ce9-8da0-29a47b4b95a2&title=NationalEnergyAndClimatePlanOfUkraine2025-2030

97 European Commission. (2023). *Ukraine Report 2023.* European Commission Enlargement Package. https://neighbourhood-enlargement.ec.europa.eu/ukraine-report-2023_en

98 Kurbatova, T., Sidortsov, R., Trypolska, G., Hulak, D., & Sotnyk, I. (2024). *Maintaining Ukraine's grid reliability under rapid growth of renewable electricity share: Challenges in the pre-war, war-time, and post-war periods.* International Journal of Sustainable Energy Planning and Management, 40, 39–51. https://doi.org/10.54337/ijsepm.8112

demonstrated that physical resilience, cyber resilience and system flexibility remain urgent research needs.[99]

Second, decentralised and distributed energy is increasingly central. The International Energy Agency highlights that a more decentralised electricity system can strengthen Ukraine's resilience while supporting decarbonisation. This creates a strong case for research on microgrids, municipal energy systems, distributed renewable generation, batteries, demand response and resilient control systems.[100]

Third, energy efficiency and buildings are critical leverage points. The NECP places energy efficiency at the centre of Ukraine's 2030 pathway. Reconstruction therefore should not simply restore buildings, but transform them into high-performance, low-energy, and resilient assets that improve living conditions and reduce long-term costs.[96,101]

Fourth, renewables, storage and flexibility represent long-term strategic priorities. Ukraine's energy strategy highlights renewable energy, hydrogen, and storage technologies, but the key research need lies in system integration, affordability, and local balancing rather than generation alone.[102]

Fifth, market, regulatory and governance reform is essential for EU alignment. Functioning energy markets require transparent procurement, credible regulation, consumer protection and investment frameworks. This makes institutional innovation as important as technological innovation.[97]

Sixth, and most importantly in relation to this report, is the need for a just transition focused on human outcomes. Ukraine's innovation strategy emphasises improved living standards, but energy policy still risks being framed mainly in terms of supply and infrastructure. A stronger human-needs perspective would evaluate energy innovation based on reduced energy poverty, improved health, thermal comfort and resilience for vulnerable groups.

99 ENTSO-E. (2022). *Continental Europe successful synchronization with power systems of Ukraine and Moldova. European Network of Transmission System Operators for Electricity.* https://www.entsoe.eu/news/2022/03/16/continental-europe-successful-synchronisation-with-ukraine-and-moldova-power-systems/

100 International Energy Agency. (2024). *Ukraine's Energy Security.* IEA. https://www.iea.org/reports/ukraines-energy-security

101 European Bank for Reconstruction and Development. (n.d.). *The war on Ukraine.* EBRD. https://www.ebrd.com/home/what-we-do/focus-areas/war-on-Ukraine.html and related pages and EBRD materials.

102 International Renewable Energy Agency. (2015). *REmap 2030: Renewable energy prospects for Ukraine.* IRENA. https://www.irena.org/Publications/2015/Apr/Renewable-Energy-Prospects-for-Ukraine

## 5.2. Key energy research and innovation needs in Ukraine

### 5.2.1. War-resilient distributed energy systems

Ukraine is becoming a global testbed for energy systems operating under deliberate attack. This creates a need for applied research on distributed architectures capable of maintaining critical services even when the central grid is disrupted. Priority areas include microgrids for hospitals and schools, hybrid systems combining solar, batteries and efficient heating, protected substations, mobile generation units, fast repair logistics and cyber-secure control systems. The central challenge is not only increasing generation capacity, but designing systems that fail gracefully and recover rapidly under extreme conditions.[100,103]

### 5.2.2. Energy-positive reconstruction of buildings and districts

Reconstruction will shape Ukraine's energy demand and social outcomes for decades. This creates a strong case for research and demonstration projects focused on deep renovation, high-performance buildings, heat pumps, district-level energy systems, passive survivability during outages, and procurement models that prioritise lifecycle performance. Energy innovation in this domain directly affects daily life by improving comfort, health, affordability and security.[101]

### 5.2.3. Modern district heating and heat resilience

Heat systems are strategically critical in Ukraine, particularly given harsh winter conditions and vulnerability of centralised infrastructure. Ukraine-specific research, feasibility studies and demonstration projects are needed on low-temperature district heating, waste-heat recovery, large-scale heat pumps, thermal storage, sustainable local biomass and integrated or hybrid heat-and-power systems capable of maintaining essential services during outages and attacks. Municipal utilities must be central actors in this transformation, as they manage many of the systems that directly affect citizens' daily lives.[104]

### 5.2.4. Digital energy systems, AI and cyber resilience

Ukraine's resilient digital infrastructure, substantial software-development sector, skilled technology workforce and emerging AI ecosystem provide a strong foundation for integrating digital technologies into energy-system recovery and modernisation. Relevant research priorities include digital twins for power networks, AI-enabled forecasting and disruption management, interoperable and secure data exchange, and cybersecurity for increasingly distributed energy infrastructure. Such innovation should be assessed not only in terms of operational efficiency, but also by its contribution to continuity of essential services, and human outcomes such as affordability, inclusion, safety and the needs of vulnerable communities.[105]

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103 Ministry of Digital Transformation of Ukraine. (2024). *WINWIN: Ukraine's global innovation strategy* [Presentation]. https://winwin.gov.ua/assets/files/WINWIN_Main%20Presentation.pdf

104 Usenko, J., Savytskyi, O., & Mikhnych, V. (2025, May). *Status of municipal heat supply in Ukraine: Challenges and solutions from the bottom up* (Version 1.1). Green Deal Ukraïna, Helmholtz-Zentrum Berlin für Materialien und Energie. https://greendealukraina.org/assets/images/reports/status-of-municipal-heat-supply.pdf

105 International Telecommunication Union. (2025). *Ukraine digital development country profile* (Version 3.0). https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Publications/2025/Final_Ukraine%20Digital%20Development%20Country%20Profile%20version%203.0.pdf and related ITU sources.

### 5.2.5. Industrial and supply-chain innovation

Energy reconstruction can support Ukraine's broader industrial and economic modernisation. The OECD Ukraine Country Programme, supporting the reconstruction and modernisation of Ukraine, links recovery to EU alignment, sustainable reconstruction, energy-system recovery and the transition to a secure and sustainable energy future. It also identifies Ukraine's outdated, energy-intensive industrial base and energy-inefficient infrastructure as issues that should be addressed during rebuilding.[106]

Ukraine will require significant investment in renewable energy technologies, grid connection and stability, renewable heat, storage, energy efficiency, and associated equipment, materials and services. IRENA's analysis shows that expanding renewables could reduce import dependence and emissions, but would require predictable policy, improved grid access, affordability assessment, domestic and foreign investment, and greater availability of affordable and reliable renewable-energy equipment.[102]

Research and innovation should identify which value chains can be developed domestically or in partnership with EU countries, and where Ukraine can become a global supplier of resilience-oriented energy solutions.

### 5.2.6. Governance, finance and procurement for mission-oriented energy innovation

The report highlights that Ukraine's most effective innovation ecosystems are those with clear users, urgent needs and operational platforms. Energy currently lacks such a coordinating mechanism. A key research and policy challenge is therefore to design governance, procurement and financing models that align municipalities, utilities, startups, universities and donors around concrete missions such as resilient hospitals, energy-secure communities and efficient housing systems. These governance and financing models should incorporate sustainability screening, environmental safeguards and proportionate verification, as developed further in section 8.4.

106 OECD. (2023). *OECD-Ukraine country programme*. OECD. https://www.oecd.org/content/dam/oecd/en/about/programmes/grc/grc-eurasia/Ukraine-Country-Programme.pdf

# 6. Resilient energy systems in Ukraine

**Summary**
Chapter 6 defines energy and service resilience and establishes a measurement framework prior to later evidence and project analysis. Ukraine's experience under repeated attacks provides an exceptional evidence base but does not show that technologies are inherently resilient or that Ukraine has a mature decentralised system. Resilience is a system's capacity to anticipate, withstand, adapt, respond and recover. Distribution can reduce single-point failures, but remains exposed to attack, cyber threats, maintenance, fuel and coordination constraints.

Decentralised energy strengthens critical-service resilience only when designed around specific functions and supported by governance, maintenance, finance and operational capacity. Evidence concerns healthcare, water, sanitation, heating, housing and transport. Ukraine's contribution may therefore be as much organisational as technological: shifting attention from installed generation to service continuity when central infrastructure fails.

**Conclusions for Energy Innovation**
Reliability metrics assess routine performance under expected conditions; resilience metrics assess extreme disruptions. SAIDI and SAIFI measure outage duration and frequency but do not distinguish critical loads. Resilience measures include energy not served, critical load served, recovery time, loss/recovery trajectories and value of lost load. Future research could use service indicators for clinical operations, water and sanitation, safe temperatures, building functions and transport.

**Recommendations and Proposed Directions**
1. Proposed direction: Treat decentralised energy as an enabler of essential-service continuity, not an end in itself.
2. Research direction: Compare configurations of technologies, business models, governance and non-governmental organisations rather than labelling technologies resilient.
3. Measurement direction: Combine system metrics with service-specific indicators for healthcare, water, sanitation, heating, housing and transport.
4. Strategic research opportunity: Study how distributed resources maintain services under repeated disruption without overstating system maturity.

**Chapter Structure**
Section 6.1 defines resilience and decentralisation's strategic case.
Sections 6.1.2-6.1.4 cover service resilience, metrics and essential-service indicators.

## 6.1. Energy resilience and decentralisation

Since the full-scale Russian invasion in February 2022, Ukraine has become an unprecedented real-world laboratory for energy resilience. Repeated attacks on generation facilities, substations, transmission infrastructure, fuel supply chains, and district energy systems have created conditions rarely studied in modern energy-system research. As a result, Ukraine's experience provides a unique opportunity to examine what kind of energy systems can contribute to resilience in critical infrastructure and public services.[107,108]

Public discussions often frame decentralised energy as inherently resilient. However, resilience is not a property of a technology. Rather, resilience describes the ability of a system to anticipate, withstand, adapt to, respond to, and recover from disruptive events.[109,110] The scientific question is therefore not whether solar photovoltaics, batteries, microgrids, combined heat and power plants, or distributed generators are resilient in themselves. The relevant question is whether particular configurations of energy technologies, combined with business models, governance structures and non-governmental organisations can ensure continuity of essential services during disruptions.

The Ukrainian experience suggests that decentralised energy could be understood primarily as an enabler of service continuity rather than as an end in itself. The strongest evidence concerns the maintenance of healthcare services, water supply, sanitation, heating, housing functions, and transport operations during repeated disruptions to centralised energy infrastructure.

### 6.1.1. The Strategic Case for Decentralisation in Ukraine

The International Energy Agency (IEA) argues that distributed energy resources should become a central component of Ukraine's energy reconstruction strategy because they can simultaneously address energy security, resilience, flexibility, and decarbonisation objectives. According to the IEA, nearly two-thirds of Ukraine's dispatchable power generation capacity has been occupied, damaged, or destroyed since the beginning of the invasion.

The vulnerability of highly centralised infrastructure has become increasingly apparent. Large generation facilities and major transmission nodes represent concentrated targets whose disruption can affect millions of people simultaneously. Distributed energy resources, by contrast, reduce dependence on single points of failure by dispersing generation, storage, and control functions across multiple locations.[108]

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107 International Energy Agency. (2024). *Empowering Ukraine Through a Decentralised Electricity System*. Paris: IEA. https://www.iea.org/reports/empowering-ukraine-through-a-decentralised-electricity-system

108 International Energy Agency. (2024). *Ukraine's Energy Security and the Coming Winter.* Paris: IEA. https://www.iea.org/reports/ukraines-energy-security-and-the-coming-winter

109 National Renewable Energy Laboratory (NREL). (2023). *Measuring and Valuing Resilience: A Literature Review for the Power Sector.* Golden, CO: NREL. https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Electic-Power-Delivery/Measuring-and-Valuing-Resilience-A-Literature-Review-for-the-Power-Sector.pdf

110 E.DSO for Smart Grids. (2024). *Climate Resilience Metrics for Electricity Grids.* Brussels. https://www.edsoforsmartgrids.eu/content/uploads/2024/06/e.dso-position-paper-climate-resilience-metrics-for-electricity-grids.pdf

However, the evidence does not suggest that decentralisation eliminates vulnerability. Rather, it changes the nature of vulnerability. Distributed systems still face physical attacks, cyber threats, maintenance challenges, fuel constraints, and coordination problems. Their value lies in reducing the probability that a single attack causes widespread service failure.

Ukraine's experience therefore supports a more nuanced proposition: decentralised energy systems can increase the resilience of critical services when they are designed around specific service functions and supported by appropriate governance, maintenance, financing, and operational capabilities.

### 6.1.2. From Energy Resilience to Service Resilience

A notable feature of Ukrainian decentralisation efforts is that they are often justified by the need to protect specific public services rather than by abstract energy-system objectives. The strongest documented examples involve hospitals, clinics, water utilities, wastewater systems, heating facilities, apartment buildings, and transport infrastructure. In these cases, distributed energy assets function as service-enabling infrastructure rather than merely electricity-producing assets. Table C6.1 illustrates a service-oriented framework for evaluating resilience.

**Table C6.1. Service-oriented resilience framework**

| Service | Primary resilience objective | Example decentralised assets | Key outcome |
|---|---|---|---|
| **Health-care** | Maintain clinical operations | Solar PV, batteries, microgrids, backup generation | Continued treatment during outages |
| **Water supply** | Maintain pumping and treatment | Solar PV, storage, pump controls | Continuous water delivery |
| **Waste-water** | Maintain sanitation functions | Local power supply, automation | Reduced public health risks |
| **Heating** | Maintain thermal comfort | CHP, modular heating units, heat pumps | Reduced winter vulnerability |
| **Housing** | Maintain essential building services | Building-scale PV and storage | Continued operation of lifts, pumps and shelters |
| **Trans-port** | Maintain critical operations | Distributed generation and microgrids | Reduced disruption to logistics |

This service-based perspective aligns with recent resilience literature, which increasingly emphasises the performance of societal functions rather than the survival of individual infrastructure assets. Attacks on energy infrastructure also create cascading disruption beyond electricity supply, affecting digital service delivery and municipal service operations.[111]

111 Cambridge University Press. (2024). *3 - Resilience Models and Metrics.* In Resilience Engineering for Power and Communications Systems. https://www.cambridge.org/core/books/resilience-engineering-for-power-and-communications-systems/resilience-models-and-metrics/27F2536D13F8A345D8185DE3395E4A3E
World Bank, European Commission, United Nations, & Government of Ukraine. (2024). *Ukraine rapid damage and needs assessment (RDNA4): February 2022–December 2024*. https://www.worldbank.org/en/country/ukraine/publication/rapid-damage-and-needs-assessment

### 6.1.3. Measuring Energy-System Resilience

One of the major challenges in resilience research is the lack of universally accepted metrics. Traditional power-system planning has historically focused on reliability rather than resilience. Reliability metrics measure routine performance under expected conditions, whereas resilience metrics evaluate performance during extreme disruptions.[111,112] Several established approaches are used in the literature.

**Table C6.2. Common resilience and reliability metrics**

| Metric | Description | Relevance for Ukraine |
|---|---|---|
| **SAIDI** | System Average Interruption Duration Index | Measures average outage duration experienced by users |
| **SAIFI** | System Average Interruption Frequency Index | Measures average number of outages |
| **CAIDI** | Customer Average Interruption Duration Index | Measures restoration efficiency |
| **Energy Not Served (ENS)** | Total unmet electricity demand | Captures severity of disruptions |
| **Critical Load Served** | Percentage of critical demand maintained | Highly relevant for hospitals and water systems |
| **Recovery Time** | Time required to restore service | Important under repeated attacks |
| **Resilience Triangle** | Loss of functionality over time and recovery trajectory | Useful for comparing system architectures |
| **Value of Lost Load (VoLL)** | Economic impact of service interruptions | Supports cost-benefit analysis |

SAIDI and SAIFI remain among the most widely used indicators internationally because they quantify outage duration and outage frequency, respectively.[113,113] However, these metrics alone are insufficient for understanding resilience under wartime conditions because they do not distinguish between critical and non-critical loads.

Resilience literature increasingly advocates performance-based approaches that measure the ability of infrastructure to maintain critical functions during and after disruptive events.[110,114] The so-called resilience triangle framework evaluates both the magnitude of functionality loss and the speed of recovery following a disruption.[114,115]

For Ukraine, service-specific resilience metrics may be particularly important because maintaining critical functions is often more important than maintaining normal operations.

112 Sia Partners. (2025). *Improving SAIDI and SAIFI: strategies for distribution system operators to achieve excellence.* https://www.sia-partners.com/en/insights/publications/improving-saidi-and-saifi-strategies-distribution-system-operators-achieve

113 Electricity Forum. (n.d.). *Electric Utility Reliability Metrics and Outage Performance Measurement.* https://electricityforum.com/ai/grid-resilience/electric-utility-reliability-metrics

114 Chen, C. et al. (2023). *A Comparative Analysis of Performance-Based Resilience Metrics via a Quantitative-Qualitative Combined Approach.* International Journal of Disaster Risk Science. https://link.springer.com/article/10.1007/s13753-023-00519-5

115 Poulin, C., & Kane, M. (2021). *Infrastructure Resilience Curves: Performance Measures and Summary Metrics.* https://arxiv.org/abs/2102.01009

### 6.1.4. Measuring Resilience in Essential Services

Future research could benefit from a focus on service continuity indicators. For healthcare systems, relevant indicators include reduction in outage hours, percentage of critical medical equipment remaining operational, avoided cancellations of procedures, patient throughput during outages, and hours of autonomous operation. For water utilities, indicators include hours of uninterrupted water delivery, avoided service interruptions, percentage of population served during outages, pumping continuity, and continuity of sanitation functions.

For heating systems, indicators include heating continuity during winter disruptions, indoor temperature maintenance, thermal autonomy, and number of residents protected from unsafe temperatures. For transport systems, indicators include operational continuity, delays avoided, logistics throughput maintained, and recovery time following outages.

The evidence available today does not support the claim that Ukraine has already established a mature decentralised energy system. However, it does support a stronger and more scientifically defensible conclusion: Ukraine is generating one of the world's most important evidence bases on how distributed energy resources can support continuity of essential services under conditions of severe and repeated infrastructure disruption.

The most significant contribution of the Ukrainian experience so far may therefore be organisational, related to how groups collaborate, rather than technological. It shifts attention from energy infrastructure alone toward service resilience. Under this framing, the key question is not how much decentralised generation has been installed, but how effectively distributed energy systems help maintain healthcare, water supply, sanitation, heating, housing functions, mobility, and other essential services when conventional infrastructure fails.

Understanding this relationship between decentralised energy and service continuity may become one of the most important energy-system research agendas of the coming decade.

# 7. Pathways for resilient energy systems in Ukraine

**Summary**
Chapter 7 assesses how Ukrainian decentralised-energy systems and projects help essential services continue during disruption. It distinguishes operational systems from pilots, investments, reforms and concepts. Category A covers implemented activities; Category B covers future pathways and enablers.

Ukraine is deploying solutions for healthcare, water, sanitation, heating, housing, storage and logistics. Evidence is strongest for healthcare and water/wastewater; VPP/flexibility and energy-positive districts remain less mature. Kyiv and Kharkiv are the strongest visible multi-theme research clusters, with other capability signals. Emerging opportunities include replicable service packages, heat, flexibility markets, energy management and green reconstruction. Regulatory readiness, pilots and pipelines are not considered operational deployment.

**Conclusions for Energy Innovation**
Resilience depends on architecture, governance, maintenance, finance, skills and measurable service outcomes. Projects should connect a human need to a technical system, local partner, resilience metric and replication path. Research questions cover comparative performance, scaling, governance and workforce, human-needs metrics, and which reconstruction architectures best support resilience, affordability and sustainability.

**Strategic Opportunities and Next Steps**
1. Potential demonstrators: Replicable hospital and water packages, apartment/community systems, heat resilience, municipal flexibility pilots and green-reconstruction living labs.
2. Proposed investment approach: Use focused 1-10 MSEK projects for feasibility, monitoring, pilots, technical assistance, research and demonstrations, not full infrastructure.
3. Proposed enabling platform: Create cross-project monitoring of outage duration, critical-load availability, service continuity and recovery trajectories.
4. Strategic programme opportunity: Frame Swedish-Ukrainian cooperation around human-needs-oriented service resilience, using Swedish strengths in systems integration, research, digitalisation, municipal planning and governance.

**Chapter Structure**
Section 7.1 separates implemented systems from pathways and maps, themes, locations and research capacity.
Section 7.2 develops demonstrators, research questions and programme framing.

## 7.1. Evidence and capacity mapping

### 7.1.1. Category A – Implemented Decentralised Energy Systems in Ukraine

***Healthcare continuity***

Healthcare represents the strongest and most clearly documented area of decentralised energy deployment. Types of implementation include hybrid solar-and-battery systems at regional hospitals, and solar installations comprising panels, inverters and batteries in clinics across Ukraine, with primary-care facilities prioritised for alternative power.[116,117,118]

Examples include Slobozhanske Hospital, Brovary Regional Hospital, the World Bank HEAL clinic portfolio, the Zaporizhzhia primary-care microgrid, and Horenka outpatient clinic reconstruction projects. These systems demonstrate how decentralised energy can contribute to continuity of healthcare functions during outages, including diagnostics, communications, refrigeration of medicines, emergency treatment, and basic clinical operations.[116,117,118,119,120]

From a resilience perspective, these projects are significant because they directly support critical societal functions rather than simply increasing renewable-energy generation capacity.

***Water supply, wastewater and sanitation***

Water infrastructure constitutes a second major implementation area. Operational examples include solar-powered water utilities and solar-plus-storage systems in Slobozhanska, Chortkiv, Sumy, Chornomorsk, and Shatsk.[121,122,123,124,125]

Importantly, the Ukrainian experience demonstrates that water resilience extends beyond solar deployment. Additional evidence includes wastewater modernisation, pumping-

116 RepowerUA. (2025). *Solar Installation at Slobozhanske Hospital.* https://repowerua.org/projects/uk-companies-power-critical-healthcare-solar-installation-at-slobozhanske-hospital

117 SolarPower Europe. (2025). *Brovary Regional Hospital Goes Solar.* https://www.solarpowereurope.org/news/solar-for-ukraine-brovary-s-hospital-goes-solar

118 World Bank. (2025). *Ukraine's Health Clinics Use Solar Power to Overcome Electrical Outages.* https://www.worldbank.org/en/news/feature/2025/11/21/ukraines-health-clinics-use-solar-power-to-overcome-electrical-outages

119 Zaporizhzhia City Administration. (2025). *A unique solar power plant was launched in the city PHC Center*. [Translated] https://zp.gov.ua/news/225380-u-miskomu-centri-pmsd-zapraciuvala-unikalna-soniacna-elektrostanciia

120 Greenpeace Ukraine. (2024). *The history of the restoration of the outpatient clinic in Gorenets is a pilot project*. [Translated] https://www.greenpeace.org/ukraine/nasha-robota/zelene-vidnovlennia/partnerstvo-zarady-vidnovlennia/zavershenyi-proiekt-horenka

121 RepowerUA. (2025). *Solar Power Plant for "Donets" Municipal Enterprise in Slobozhanska Community.* https://repowerua.org/projects/solar-power-plant-for-donets-municipal-enterprise-in-slobozhanska-community

122 Nefco. (2025). *Ukraine's first completed solar-powered critical infrastructure project sparks a sustainable energy shift.* https://www.nefco.int/news/ukraines-first-completed-solar-powered-critical-infrastructure-project

123 UNICEF Ukraine. (2025). *Solar energy helps ensure continuous water supply in Sumy.* https://www.unicef.org/ukraine/en/stories/solar-energy-ensure-continuous-water-supply

124 State Agency on Energy Efficiency and Energy Saving of Ukraine. (2025). *Advantages of solar power plants for water supply*. [Translated] https://saee.gov.ua/news/perevagi-soniacnix-elektrostancii-dlia-vodokanalu

125 Rayon.in.ua. (2025, 22 July). *A solar power plant began operating in Shatsk to ensure stable operation of wastewater treatment facilities*. [Translated] https://shatsk.rayon.in.ua/news/822643-u-shatsku-zapratsyuvala-sonyachna-elektrostantsiya-dlya-stabilnoi-roboti-ochisnikh-sporud

station upgrades, frequency converters, pressure-management systems, and wastewater automation in Kherson, Khmelnytskyi and Lviv.[126,127,128,129]

This suggests that service continuity in water systems depends on integrated technical and organisational solutions rather than on distributed electricity generation alone.

***Heating and winter resilience***

Winter resilience is a critical dimension of Ukrainian energy security. Implemented projects and equipment deployments include modular hospital heating units, [130] mobile boiler systems, [131] gas-piston cogeneration units, [132,133] commissioned municipal cogeneration installations, including Kamianets-Podilskyi, [134] and a completed heating pilot in Trostyanets integrating heat pumps, geothermal energy, heat storage and solar power.[135,136]

These interventions should primarily be understood as resilience measures designed to maintain thermal comfort and protect public health during infrastructure disruptions. Some contribute directly to decarbonisation, while others provide transitional or emergency energy services.

***Housing and community resilience***

Apartment-building and community-level systems provide important examples of locally governed resilience solutions. Projects in Kyiv and Odesa demonstrate how building co-owner associations have deployed distributed solar and battery systems to maintain essential building services – including lifts, pumps, lighting, and communication and security

126 Ukr.net. (2025). *A solar power plant has started operating in Shatsk for the stable operation of wastewater treatment plants.* [Translated] https://www.ukr.net/news/details/lutsk/112545435.html

127 Nefco. (2023). *Energy efficiency and sustainability: modernising water supply systems in Ukraine*. https://www.nefco.int/news/energy-efficiency-and-sustainability-modernising-water-supply-systems-in-ukraine

128 Intent. (2023). *New control stations installed at water-supply and wastewater facilities in Kherson*. [Translated]. https://intent.press/news/localgovernment/2023/novi-stanciyi-upravlinnya-vstanovili-na-obyektah-vodopostachannya-ta-vodovidvedennya-v-hersoni

129 Nefco. (2025). *Nordic countries contribute to the modernisation of wastewater treatment in Lviv, Ukraine*. https://www.nefco.int/news/nordic-countries-contribute-to-the-modernisation-of-wastewater-treatment-in-lviv-ukraine/

130 United Nations Ukraine. (2024). *WHO Installs Modular Heating Units in Ukrainian Hospitals to Prepare for Winter.* https://ukraine.un.org/en/269524-who-installs-modular-heating-units-ukrainian-hospitals-prepare-winter

131 Ukrainian Red Cross Society. (2024). *The Ukrainian Red Cross and The Coca-Cola Company continue to provide local communities with mobile boilers.* https://redcross.org.ua/en/news/2024/10/96041/

132 United Nations Development Programme. (2024). *Ukraine receives gas-piston cogeneration units to support Kharkiv's critical energy needs.* https://www.undp.org/ukraine/press-releases/ukraine-receives-gas-piston-cogeneration-units-support-kharkivs-critical-energy-needs

133 United Nations Development Programme. (2024). *Gas-piston cogeneration units delivered to Odesa by UNDP to cover 45% of city's energy needs for water, heating, and sewage services*. https://www.undp.org/ukraine/press-releases/gas-piston-cogeneration-units-delivered-odesa-undp-cover-45-citys-energy-needs-water-heating-and-sewage-services

134 Kamianets-Podilskyi Municipality. (2025). *A New Cogeneration Unit Began Operating in Kamianets-Podilskyi.* https://kam-pod.gov.ua/novini/town-news/item/53768-shche-odyn-krok-do-enerhonezalezhnosti-u-kamyantsipodilskomu-zapratsyuvala-nova-koheneratsiyna-ustanovka

135 Greenpeace Ukraine. (2025). *Green Reconstruction: Greenpeace Organisations Fully Supply First Multi-apartment Block in Ukraine with Heat Pumps*. https://www.greenpeace.org/ukraine/en/news/5243/green-reconstruction-greenpeace-organisations-fully-supply-first-multi-apartment-block-in-ukraine-with-heat-pumps/

136 Trostyanets City Council. (2026). *"Sahara" Company Has Completed the Commissioning of a Modern Heating Station in a Renovated Apartment Building*. https://global.trostyanets-miskrada.gov.ua/news/sahara-company-has-completed-the-commissioning-of-a-modern-heating-station-in-a-renovated-apartment-building/

systems – during power outages.[137,138] Reconstruction projects in Irpin and Bucha provide complementary examples of housing and community resilience through the restoration of damaged apartment buildings and the development of temporary and modular housing solutions.[139,140]

These examples highlight the importance of governance, ownership structures, maintenance capacity, and community organisation. The evidence suggests that resilience outcomes depend not only on technical infrastructure but also on institutional arrangements that enable collective action.

**Grid-edge storage, control systems and logistics infrastructure**
Ukraine has also begun developing and deploying operational battery storage systems, energy-management systems, and facility-level control architectures.[141] The strongest example is the CERU initiative, which combines solar generation, battery storage, EMS/MMS systems, essential-load prioritisation, and selective load shedding.[142] Additional evidence comes from DTEK/Fluence and KNESS storage deployments.[141,143]

Distributed generation assets are also being deployed to support Ukraine's transport infrastructure. In July 2025, 18 containerised gas-piston power stations totalling 41.4 MW were delivered to Ukrainian Railways for deployment as flexible, backup and autonomous generation at critical railway facilities amid continuing attacks on Ukraine's energy system.[144]

### 7.1.2. Category B – Future-Relevant Opportunities

While Category A demonstrates current practice, Category B identifies pathways that could contribute to resilience, wellbeing, and flourishing lives but should not yet be described as operational systems.

137 Energy Efficiency Fund of Ukraine. (2025). The "Pulyuya 2" condominium installed a solar power plant under the "GreenDIM" program and ensured partial energy independence for the building. https://eefund.org.ua/istoriyi-uspihu/osbb-pulyuya-2-vstanovylo-ses-za-programoyu-grindim-i-zabezpechylo-chastkovu-energonezalezhnist-budynku
138 Energy Efficiency Fund of Ukraine. (2025). Zodiac condominium protected the house from blackouts. https://eefund.org.ua/istoriyi-uspihu/krok-do-energetychnoyi-nezalezhnosti-osbb-zadiak-zahystylo-budynok-vid-blekautiv
139 United Nations Development Programme. (2024). *Two war-damaged apartment buildings in Irpin fully restored through United24 and UNDP project*. https://www.undp.org/ukraine/press-releases/two-war-damaged-apartment-buildings-irpin-fully-restored-through-united24-and-undp-project
140 European Commission, New European Bauhaus. (2022). *Housing Urgency in Ukraine (Project A)*. https://new-european-bauhaus.europa.eu/system/files/2023-02/221109_NEB_Project_A.pdf
141 Liga Business. (2025). *The first domestically developed industrial energy storage system was launched in Ukraine*. [Translated] https://biz.liga.net/ua/tek/news/v-ukraini-zapustyly-pershyy-promyslovyy-nakopychuvach-enerhii-vitchyznianoi-rozrobky
142 InnovateUkraine. (2025). *Critical Energy Resilience for Ukraine (CERU)*. https://innovateukraine.io/case_study/critical-energy-resilience-for-ukraine-ceru-enhancing-energy-resilience-through-innovation
143 Fluence. (2025). *DTEK and Fluence energise the largest energy storage portfolio in Ukraine with a total capacity of 200 MW*. https://ir.fluenceenergy.com/news-releases/news-release-details/dtek-and-fluence-energise-largest-energy-storage-portfolio
144 Energy Community Secretariat. (2025). *18 gas-piston power stations delivered to JSC "Ukrainian Railways" under the Ukraine Energy Support Fund*. 22 July 2025. https://www.energy-community.org/news/Energy-Community-News/2025/07/22.html

***Replicable critical-service resilience packages***

One of the most important future opportunities concerns the development of standardised resilience packages for hospitals, schools, water utilities, community facilities, and municipal services.

The current evidence demonstrates that distributed energy can support continuity of critical services. The next challenge is determining how successful examples can be transformed into replicable and maintainable solutions that can be deployed at scale. Such systems are important because they directly support access to healthcare, education, water, sanitation, safety, and local public services.

***Decentralised heat systems and thermal wellbeing***

Future opportunities also exist in decentralised heat systems, particularly where reconstruction efforts can integrate heat pumps, thermal storage[135], modular heating systems,[130] and district-heating architectures.[145,146]

Projects such as UA-GRIDEX provide important modelling and planning foundations for this work, although they should be understood as enabling activities rather than operational installations.[147]

The importance of heat resilience extends beyond energy security. Thermal comfort is closely linked to public health, wellbeing, dignity, and quality of life, particularly during winter disruptions.

***Flexibility markets, aggregation and demand response***

Ukraine has established several important enabling mechanisms for future flexibility markets, including storage procurement processes, aggregator licensing, and market reforms. However, current evidence does not support claims regarding operational virtual power plants or mature demand-response systems at community or municipal scale. These should therefore be described as future opportunities rather than current achievements.[148,149,150]

Future research should explore how flexibility resources can contribute not only to grid balancing but also to resilience and continuity of essential services.

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145 United Nations Development Programme. (2025). *EIB and UNDP forge new partnership to accelerate Ukraine's green energy transition*. https://www.undp.org/ukraine/press-releases/eib-and-undp-forge-new-partnership-accelerate-ukraines-green-energy-transition

146 Government Offices of Sweden. (2024). *New Energy Package to Strengthen Ukraine's Resilience*. https://www.government.se/press-releases/2024/05/new-energy-package-to-strengthen-ukraines-resilience

147 Swedish Institute. (2025). *Building resilience: Swedish Institute funds project to support Ukraine's energy infrastructure*. https://si.se/en/building-resilience-swedish-institute-funds-project-to-support-ukraines-energy-infrastructure

148 Avellum. (2023, October 23). *NEURC makes next step in introducing aggregation in Ukrainian energy market*. https://avellum.com/neurc-makes-next-step-in-introducing-aggregation-in-ukrainian-energy-market/

149 CMS Cameron McKenna Nabarro Olswang. (2026). *Guidebook for energy storage in Ukraine: Market development and regulatory framework*. https://cms.law/en/ukr/legal-updates/guidebook-for-energy-storage-in-ukraine-market-development-and-regulatory-framework

150 Ukrenergo. (2025). *Tender for Construction of Generating Capacity*. https://ua.energy/for_market_participants/tender-for-the-construction-of-generating-capacity

***Green reconstruction and human-centred energy systems***

Green reconstruction projects in Horenka, Trostyanets and Khotyn suggest opportunities to integrate energy resilience with broader societal goals including health, housing quality, accessibility, local economic development, and environmental sustainability. Current evidence supports the existence of pilots and demonstration projects. It does not yet support claims regarding large-scale deployment of energy-positive districts or passive-house reconstruction programmes. [136,151,152,153,154,155,156,157]

Nevertheless, these initiatives provide valuable opportunities for exploring how reconstruction investments can simultaneously support resilience, decarbonisation, and human flourishing.

### 7.1.3. Major theme mapping

Table C7.1 brings together the implemented activities discussed in section 7.1 and the emerging pathways identified in section 7.2, summarising evidence strength and key interpretive cautions across the major themes.

**Table C7.1. Summary of the current state of evidence across major thematic areas**

| Theme | Category A Evidence | Category B Evidence | ES* | Main Caution |
|---|---|---|---|---|
| **Health facility solar, storage and microgrids** | Implemented hospitals, clinics and primary-care microgrids | Hospital and school pipelines, portfolios and tenders | S | Separate operational sites from pipeline and portfolio evidence |
| **Water and wastewater solar/storage** | Implemented water and wastewater systems | Water pipeline projects | S | All systems do not include batteries or islanding capability |
| **Water/wastewater beyond solar** | Pump controls, wastewater automation, biogas CHP | Utility-modernisation pathways | M-S | Node-level resilience is evidenced; whole-network decentralisation is not |
| **Decentralised heat and winter resilience** | Modular heat, CHP, mobile boilers, heat-pump pilots | Heat finance, modelling and feasibility pathways | M-S | Resilience assets are not automatically clean-energy assets |
| **Grid-edge BESS and EMS** | Operational BESS and EMS examples | Procurement and aggregation pathways | M | Advanced AI-enabled control remains weakly evidenced |

151 Greenpeace International. (2023). *Building Ukrainian resilience: The green reconstruction of Horenka hospital*. https://www.greenpeace.org/international/story/58111/building-ukraine-resilience-green-reconstruction-horenka-hospital/

152 Khotyn City Territorial Community. (2024). *Implementing a grant project to install a solar power plant*. [Translated]. https://khotyn.dosvit.org.ua/news/grant-2024-11-05

153 Ecoclub. (n.d.). *Solar Aid for Ukraine*. https://ecoclubrivne.org/en/solar_aid4ukraine_en

154 Ro3kvit Urban Coalition for Ukraine. (2023). *Urban Coalition for Ukraine: Strategies and Proposals*. https://ro3kvit.com/projects/urban-coalition-for-ukraine-book

155 United Nations Development Programme. (2024). *Towards sustainable development: How Trostianets ATC rose up the rankings of the most successful communities in Ukraine*. https://www.undp.org/ukraine/news/towards-sustainable-development-how-trostianets-atc-rose-rankings-most-successful-communities-ukraine

156 European Commission. (2024). Actions for Ukraine. *From providing emergency assistance to rebuilding Ukraine*. https://new-european-bauhaus.europa.eu/inspiring-projects-and-ideas/actions-ukraine_en

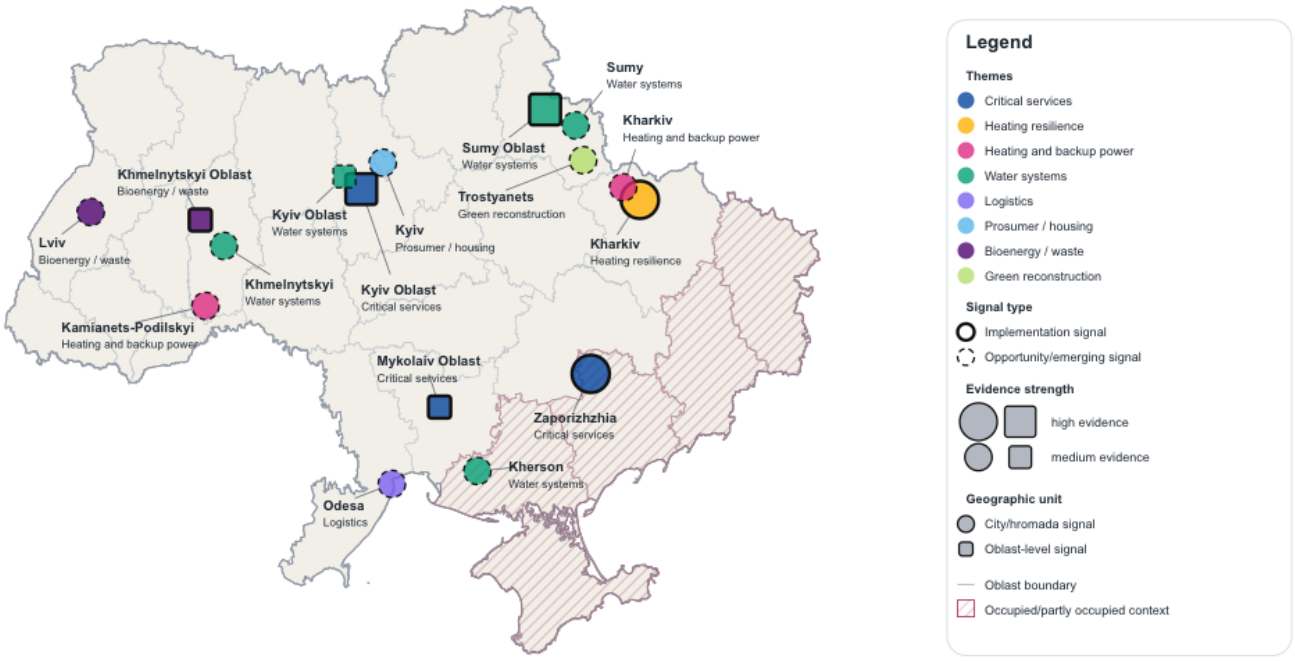
157 International Energy Agency. (2025). *Ukraine's Energy Security*. https://www.iea.org/reports/ukraines-energy-security

| | | | | |
|---|---|---|---|---|
| **VPP and demand response** | No operational evidence at community scale | Aggregator licensing and tenders | W-M | Regulatory readiness should not be confused with deployment |
| **Community and housing resilience** | Apartment-building resilience systems | Replication pathways | M | Evidence is stronger for building co-owner systems than for energy communities |
| **Energy-positive districts** | Pilot projects and reconstruction examples | Finance and design pathways | W-M | Pilots but not mainstream practice |
| **Industrial and logistics resilience** | Rail power stations | Port of Odesa microgrid pathway | M | Strong for resilience, weaker for community-facing benefits |
| **Bioenergy and waste-to-energy** | Lviv biogas CHP and VITAGRO biomethane | Biomethane feasibility pathways | M | Local resilience benefits vary significantly between cases |
| * ES= Evidence Strength | S= Strong<br>M= Moderate<br>W= Weak | | | |

### 7.1.4. Concentrations of decentralised energy project implementations

Figure C7.1 shows where evidence points to current or emerging concentrations of decentralised-energy activity in Ukraine grouped around themes. It highlights city, hromada and oblast-level signals across critical-service microgrids, heating resilience, water and wastewater systems, logistics energy resilience, prosumer housing, bioenergy and green reconstruction.

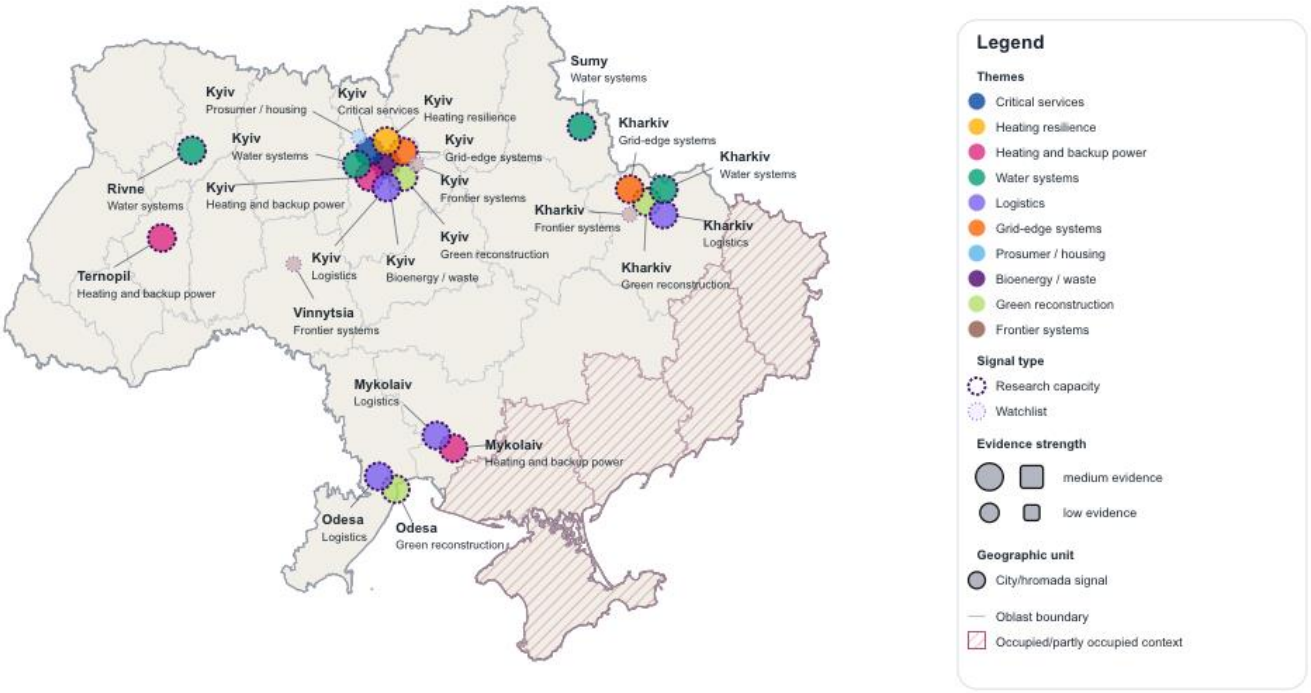
**Figure C7.1. Decentralised energy and resilience project concentrations**



## 7.1.5. Concentrations of decentralised research projects

Figure 7.2 identifies locations with academic, technical or innovation capability relevant to realised decentralised energy projects. Kyiv and Kharkiv are the strongest multi-theme research clusters, spanning grid-edge systems, water resilience, green reconstruction, heating, bioenergy, logistics and frontier energy-system topics. Additional research-capacity signals appear in Mykolaiv, Odesa, Rivne, Sumy, Ternopil and Vinnytsia. These signals should be read as visible collaboration and capability indicators.

**Figure C7.2. Decentralised energy and resilience research concentrations**



## 7.2. Potential demonstrators and research priorities

Building on the evidence and capacity mapped in section 7.1, this section translates the findings into potential Swedish–Ukrainian demonstrators, strategic programme framing and cross-cutting research questions.

### 7.2.2. Potential energy resilience projects for financing

The evidence reviewed in this report suggests that the most promising projects for financing in the 1-10 MSEK range are focused demonstrators that connect decentralised energy systems to measurable continuity of essential services. This scale of financing is particularly well suited for feasibility studies, replication packages, monitoring systems, municipal pilots, technical assistance, applied research, and small-to-medium demonstration projects. It is less suited to full-scale infrastructure deployment, but highly relevant for generating evidence, reducing risk, and preparing larger investment programmes.[158,159]

A useful selection principle is that each financed project should connect a specific human need to a specific technical architecture, a local institutional partner, a measurable resilience outcome, and a plausible pathway for replication. The proposed projects below are therefore organised around essential services rather than technologies.

***Hospital resilience packages***

Healthcare represents the strongest area of current implementation evidence in Ukraine. Existing projects include solar-powered hospitals, battery systems, hybrid energy systems, primary-care microgrids and green reconstruction projects in locations such as Kharkiv, Mykolaiv, Zaporizhzhia and Brovary. [154,160,161,162,163]

A logical next step would be to develop standardised Hospital Resilience Packages that can be replicated across multiple regions. Such projects would focus on critical-load mapping, resilience monitoring, energy management systems, operational procedures and replication methodologies. Rather than measuring success primarily through installed renewable-energy capacity, the emphasis would be placed on continuity of medical services, operation of critical equipment, avoided cancellations, and healthcare access during outages.

Potential Ukrainian partners include Energy Act for Ukraine Foundation, Repower Ukraine, local hospitals, municipal health departments and the Ministry of Health. Swedish partners could include RISE, KTH Royal Institute of Technology, Uppsala University, regional healthcare authorities, Sweco, AFRY and Hitachi Energy. Demonstration sites could include

158 International Energy Agency. (2024). *Empowering Ukraine Through a Decentralised Electricity System*. International Energy Agency. https://www.iea.org/reports/empowering-ukraine-through-a-decentralised-electricity-system

159 International Energy Agency. (2024). *Ukraine's Energy Security and the Coming Winter*. International Energy Agency. https://www.iea.org/reports/ukraines-energy-security-and-the-coming-winter

160 World Health Organization. (2025). *WHO and EU strengthen heating and water infrastructure in Ukrainian hospitals*. https://www.who.int/europe/news/item/10-12-2025-who-and-eu-strengthen-heating-and-water-infrastructure-in-ukrainian-hospitals

161 Energy Act for Ukraine Foundation. (2024). *50SolarHospitals*. https://www.energyactua.com/50solarhospitals

162 United Nations Economic Commission for Europe. (2024). *UN4UkrainianCities - Enhancing urban planning in the cities of Kharkiv and Mykolaiv in Ukraine*. https://unece.org/housing/un4ukrainiancities

163 Ministry of Health of Ukraine. (2024). *Children's Hospital in Brovary is equipped with solar panels to improve its energy efficiency*. https://moz.gov.ua/en/children-s-hospital-in-brovary-is-equipped-with-solar-panels-to-improve-its-energy-efficiency

Kharkiv, Mykolaiv, Zaporizhzhia and Brovary, where relevant implementation experience already exists, in particular Mykolaiv, which has multiple completed projects.

***Water utility resilience demonstrators***

Water supply and wastewater management constitute one of the strongest service-resilience themes emerging from the Ukrainian evidence base. Existing projects include solar-powered water utilities, solar-plus-storage systems, wastewater modernisation programmes, pressure-management systems and pumping-station upgrades in locations such as Kharkiv, Mykolaiv, Sumy, Kherson and Khmelnytskyi. [162,164,165]

Future projects should move beyond individual technology installations and instead examine integrated resilience packages combining distributed generation, storage, pump optimisation, digital monitoring and service-continuity assessment. Such projects would provide valuable evidence regarding how decentralised energy can support continuity of safe water and sanitation under prolonged infrastructure disruption.

Potential Ukrainian partners include municipal *vodokanals*, UNICEF Ukraine, NEFCO project partners and local governments. Potential Swedish partners include RISE, Stockholm Environment Institute (SEI), IVL Swedish Environmental Research Institute, Energikontor Syd, Xylem Sweden and Hitachi Energy. Kharkiv, Mykolaiv, Sumy and Kherson represent particularly promising demonstration locations because they already have documented experience with resilience-oriented water infrastructure investments.

***Apartment-building and community resilience systems***

UNDP and UNECE work in Ukraine illustrates complementary approaches to strengthening resilience that can improve local community capacity to withstand and recover from disruptions: organising apartment owners into associations and building their capacity for collective governance and energy-efficiency planning; rehabilitating war-damaged residential buildings in cooperation with local authorities; and proposing locally oriented clean-energy approaches, including energy audits in local communities and pilot projects for sustainable, resilient local energy systems.[166,167,168]

These projects are particularly interesting because they combine technical resilience with local governance and collective action. Future demonstration projects could explore scalable models for apartment buildings, neighbourhoods and community facilities that integrate solar generation, batteries, emergency shelter systems and digital monitoring.

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164 United Nations Development Programme. (2025). *United Nations Development Programme in Ukraine*. https://www.undp.org/sites/g/files/zskgke326/files/2025-07/undp-brochure_july2025_1.pdf

165 United Nations Children's Fund (UNICEF). (2025). *UNICEF Ukraine Annual Report 2024.* https://open.unicef.org/download-pdf?country-name=Ukraine&year=2024

166 Fang, J. (2021). *Final evaluation of the UNDP project: Home Owners of Ukraine for Sustainable Energy Solutions (HOUSES) – An action within the EE4U programme*. United Nations Development Programme, Independent Evaluation Office. https://erc.undp.org/evaluation/documents/download/19260

167 United Nations Development Programme. (2025). *Multi-storey apartment building in Borodianka reopens after extensive restoration work under UNITED24 programme, supported by UNDP*. https://www.undp.org/ukraine/press-releases/multi-storey-apartment-building-borodianka-reopens-after-extensive-restoration-work-under-united24-programme-supported-undp

168 United Nations Economic Commission for Europe. (2023). *Rebuilding Ukraine with a resilient, carbon-neutral energy system*. United Nations. https://unece.org/sustainable-energy/publications/rebuilding-ukraine-resilient-carbon-neutral-energy-system

Potential Ukrainian partners include the Energy Efficiency Fund of Ukraine, OSBB associations, municipalities and local civil-society organisations. Potential Swedish partners include HSB, Riksbyggen, RISE, KTH, Lund University and Swedish cleantech companies. Demonstration projects could be developed in Kyiv, Odesa, Irpin, and Bucha, where both reconstruction needs and active local governance structures are present.

***Decentralised heat and winter resilience***

Heat resilience is an increasingly important component of energy resilience, particularly in Ukraine's wartime recovery. Recent initiatives include modular heating systems for hospitals and municipalities, gas-piston cogeneration units, rehabilitation of municipal district heating infrastructure, and district heating modernization projects incorporating heat pumps.[135,169,170,171,172]

Future projects should focus on integrated thermal resilience systems that combine local generation, thermal storage, heat pumps, district-heating flexibility and emergency operation strategies. Such projects would generate valuable evidence concerning the relationship between decentralised heat systems, public health, winter resilience and quality of life.

Potential Ukrainian partners include municipal heating companies, hospitals, schools, local governments and UA-GRIDEX participants. Swedish partners could include RISE, SEI, IVL, KTH, NIBE, Alfa Laval and Vattenfall Heat. Potential demonstration sites include Kharkiv, Kamianets-Podilskyi, Horenka and Trostyanets, where delivered, operational or recently commissioned projects provide an initial foundation for further development.

***Municipal energy management and flexibility pilots***

Ukraine has established several important regulatory and market foundations for future flexibility systems, including storage procurement mechanisms, aggregator licensing and market reforms. Several Ukrainian cities have gained operational experience with decentralised generation, storage and other locally deployed flexibility measures, particularly for maintaining essential services during grid disruptions.[173,174,175]

169 European Bank for Reconstruction and Development. (2024). *EBRD, European Union and United States help Kyiv prepare for winter*. https://www.ebrd.com/home/news-and-events/news/2024/ebrd-european-union-and-united-states-help-kyiv-prepare-for-winter.html

170 International Energy Agency. (2024). *Ukraine's energy security and the coming winter*. https://www.iea.org/reports/ukraines-energy-security-and-the-coming-winter

171 Nordic Environment Finance Corporation. (2025). *Introduction of up-to-date energy efficient solutions for district heating in Poltava*. https://www.nefco.int/procurements/general-procurement-notice-introduction-of-up-to-date-energy-efficient-solutions-for-district-heating-in-poltava-ukraine/

172 World Health Organization. (2024). *WHO installs modular heating units in Ukrainian hospitals to prepare for winter*. United Nations in Ukraine. https://ukraine.un.org/en/269524-who-installs-modular-heating-units-ukrainian-hospitals-prepare-winter

173 Avellum. (2023). *NEURC makes next step in introducing aggregation in Ukrainian energy market*. https://avellum.com/neurc-makes-next-step-in-introducing-aggregation-in-ukrainian-energy-market/

174 CMS Cameron McKenna Nabarro Olswang. (2026). *Guidebook for energy storage in Ukraine: Market development and regulatory framework*. https://cms.law/en/ukr/legal-updates/guidebook-for-energy-storage-in-ukraine-market-development-and-regulatory-framework

175 Le Corre, A. (2026). *Four years of war: What Ukrainian cities' resilience teaches us*. Energy Cities. https://energy-cities.eu/four-years-of-war-what-ukrainian-cities-resilience-teaches-us/

Building on this experience, further pilot projects could explore how municipalities combine energy-management systems, distributed storage, controllable demand and critical-load protection to improve resilience. Such projects could help translate emerging regulatory and market frameworks into wider, systematic municipal implementation.

Potential Ukrainian partners include Ukrenergo, NEURC, DTEK, KNESS[176] and municipal energy offices. Potential Swedish partners include RISE, Chalmers University of Technology, KTH, ABB, Hitachi Energy, CheckWatt and Flower. Lviv and selected municipalities in the Kyiv region could serve as demonstration locations because of existing municipal energy-management initiatives and ongoing flexibility-related developments.

***Green reconstruction living labs***

Green reconstruction projects in Horenka, Trostyanets and Khotyn suggest an opportunity to transform reconstruction sites into living laboratories for resilient infrastructure.[137,151-155,177]

Rather than focusing narrowly on energy technologies, these projects could integrate housing, mobility, energy systems, digital services, health outcomes and local economic development. Such living labs would allow researchers and practitioners to study how decentralised energy contributes to broader societal objectives including wellbeing, resilience and flourishing lives.

Potential Ukrainian partners include Greenpeace Ukraine, Ecoaction, local reconstruction authorities and municipal governments. Swedish partners could include RISE, KTH, Lund University, IVL, White Arkitekter, Sweco, Skanska and NCC. Horenka, Trostyanets, Khotyn, Irpin and Bucha represent particularly promising locations because of their ongoing reconstruction activities and previous involvement in innovative rebuilding initiatives.

***Cross-Cutting Resilience Monitoring Platform***

One of the most significant gaps concerns comparable data on resilience outcomes. Comparable data on resilience outcomes remain limited. The World Bank identifies gaps in tracking recovery and some human impacts, while international guidance calls for monitoring critical-service continuity and recovery. [178,179]

A dedicated monitoring platform could support multiple demonstration projects simultaneously, tracking outage duration, critical-load availability, healthcare, water and heating continuity, and recovery trajectories. This would align with the OECD Country Programme's emphasis on coordinated monitoring of outputs and outcomes, harmonised data and indicator systems, and infrastructure-outcome monitoring to inform reconstruction and investment decisions. Resilience monitoring should also consider environmental conditions that determine whether essential services can operate safely.

176 KNESS. (2024). Energy storage systems and smart energy solutions. https://kness.energy/en/energy-storage-systems/
177 European Network of Living Labs. (2024). *Living Labs methodology and innovation ecosystems*. https://enoll.org
178 World Bank, European Commission, United Nations, & Government of Ukraine. (2024). *Ukraine rapid damage and needs assessment (RDNA4): February 2022–December 2024*.
https://www.worldbank.org/en/country/ukraine/publication/rapid-damage-and-needs-assessment
179 United Nations Office for Disaster Risk Reduction. (2022). *Principles for resilient infrastructure*.
https://www.undrr.org/publication/principles-resilient-infrastructure

Continued energy or water supply does not constitute effective resilience if contamination makes a facility or service unsafe to use. Relevant demonstrations could therefore combine service-continuity metrics with targeted environmental-health indicators where these are material.[180]

Potential Ukrainian partners include municipalities, hospitals, water utilities and ministries responsible for reconstruction and infrastructure planning. Swedish partners could include RISE, SEI, IVL, KTH and digital-service providers. A multi-city pilot involving three to five demonstration locations would likely provide the greatest learning value.

### 7.2.4. Evidence-derived research questions

Ukraine's experience raises several important research questions that extend beyond the current conflict. Drawing on the strategic needs identified in section 5.2, and the implementation evidence, emerging pathways and research capacity in section 7.1, the following questions operationalise the war-resilient distributed-energy priority identified, while also addressing cross-cutting questions of reconstruction, governance and human outcomes raised.

A first question concerns the comparative resilience of different decentralised architectures. Do hospital microgrids provide greater resilience than facility-scale backup systems? Under what conditions do batteries outperform fuel-based generators? What combinations of solar generation, storage, and controllable loads provide the greatest resilience per unit cost?

A second question concerns scale. Many current projects focus on individual facilities. Future research should examine whether resilience gains can be replicated at neighbourhood, district, municipal, and regional scales.

A third question concerns governance. Technical solutions alone do not guarantee resilience. Local maintenance capabilities, spare-part availability, operational procedures, ownership structures, financing mechanisms, and workforce training may prove equally important determinants of performance.

A fourth question concerns human needs. Existing energy resilience metrics often focus on technical infrastructure performance. Ukraine highlights the need for resilience frameworks that explicitly measure healthcare continuity, access to safe water, thermal comfort, housing functionality, mobility, and public-service delivery.

A fifth question concerns reconstruction pathways. The challenge is not simply rebuilding damaged infrastructure but determining whether distributed, hybrid, or centralised architectures provide the greatest long-term resilience, affordability, and sustainability.

180 Organisation for Economic Co-operation and Development (OECD). (2023). *Ukraine Country Programme: Key Issues Paper*. Meeting of the OECD Council at Ministerial Level, Paris, 7–8 June 2023. https://www.oecd.org/content/dam/oecd/en/about/programmes/grc/grc-eurasia/Ukraine-Country-Programme.pdf High-Level Working Group on the Environmental Consequences of the War. (2024). *An environmental compact for Ukraine: A green future—Recommendations for accountability and recovery*. European Institute of Peace. https://www.eip.org/publication/an-environmental-compact-for-ukraine

### 7.2.5. Strategic framing

The strongest strategic framing for a Swedish-Ukrainian programme is to finance human-needs-oriented service resilience. Under such a framework, decentralised energy systems are evaluated according to their contribution to healthcare continuity, safe water, sanitation, warmth, housing functionality, mobility and local public services.

This framing aligns closely with current Ukrainian needs, existing implementation evidence, resilience research and the broader objective of supporting flourishing lives under conditions of uncertainty and disruption. It could also allow Swedish actors to contribute distinctive strengths in systems integration, applied research, digitalisation, municipal planning, governance and long-term sustainability.

# D: Opportunities:
# Possible ways forward

Sweden's support to Ukraine has evolved rapidly from emergency humanitarian and military assistance into a broader long-term partnership focused on reconstruction, resilience, innovation, digitalisation and sustainable development. In this transition, research and innovation have become increasingly important tools, particularly in areas related to energy security, green transition, cybersecurity, resilient infrastructure and municipal reconstruction. The emerging Swedish–Ukrainian cooperation framework therefore creates a strong foundation for a strategic energy research and innovation partnership that combines reconstruction with long-term transformation.[181,182]

A central feature of the Swedish approach is that support for Ukraine is increasingly organised through integrated frameworks where reconstruction, resilience, innovation, EU integration and security reinforce each other. The Swedish reconstruction and reform strategy for Ukraine for 2023–2027 explicitly links reconstruction with democratic reform, sustainable development and long-term economic modernisation. The strategy allocates SEK 9 billion for cooperation activities and highlights energy, infrastructure, digitalisation, private sector development and sustainable reconstruction as priority areas.[181]

At the same time, Ukraine has positioned itself as a future strategic actor within the European energy transition. The Ukrainian GreenTech sector strategy developed within the WINWIN framework highlights Ukraine's potential in renewable energy, biomethane, hydrogen, smart grids, energy storage and AI-supported energy systems. The strategy also identifies strong opportunities for international cooperation in energy innovation and digital transformation. Ukraine's strategy argues that the country can become an important contributor to European energy security and green transformation through renewable energy, hydrogen exports, bioenergy and critical raw materials.

The bilateral Memorandum of Understanding between the Ministry of Energy of Ukraine and the Swedish Ministry of Climate and Enterprise, signed in March 2025, further strengthens this direction. The MoU establishes a formal Energy and Green Transition Partnership focused on civil nuclear cooperation, renewable energy, hydrogen, energy efficiency, electricity systems, district heating, emergency preparedness and green industrial transition. The agreement also creates opportunities for joint research, innovation, pilot projects and knowledge exchange between Swedish and Ukrainian actors.[182]

An important development is that Swedish–Ukrainian cooperation increasingly connects energy with digitalisation, cybersecurity and innovation ecosystems. In November 2025, Sweden and Ukraine signed a Letter of Intent on innovation and digitalisation cooperation that included collaboration on AI, cybersecurity, automation, semiconductors, green

181 Government Offices of Sweden. (2023). *Strategy for Sweden's reconstruction and reform cooperation with Ukraine 2023–2027*. Government Offices of Sweden. https://www.government.se/contentassets/19d253702ff94665975da196bce2b879/strategy-for-swedens-reconstruction-and-reform-cooperation-with-ukraine-20232027.pdf

182 Ministry of Climate and Enterprise of Sweden & Ministry of Energy of Ukraine. (2025). *Memorandum of Understanding on establishing an Energy and Green Transition Partnership in the field of Civil Nuclear Energy and the Green Transition*. Government Offices of Sweden. https://www.regeringen.se/contentassets/e4c34a2604014ace803c56260f66d898/samforstandsavtalet-inom-energi-och-gron-omstallning-mellan-sverige-och-ukraina-mou.pdf

transition and innovation ecosystems.[183] This demonstrates a shift from traditional development cooperation toward a strategic innovation partnership where Ukraine is seen not only as a recipient of support, but also as a co-developer of future resilience and innovation systems.

This broader strategic shift became particularly visible through the 2024 bilateral Agreement on Security Cooperation between Sweden and Ukraine. While primarily a security agreement, it explicitly connects security, infrastructure, resilience, reconstruction and industrial cooperation. The agreement includes long-term cooperation on critical infrastructure protection, innovation and industrial development.[184] This is highly relevant for energy research and innovation because modern energy systems increasingly depend on cybersecurity, digital resilience and distributed infrastructure.

The growing integration between cybersecurity and energy resilience was further reinforced through the 2026 Memorandum of Understanding on cybersecurity cooperation between Sweden and Ukraine. The agreement establishes cooperation between Sweden's National Cyber Security Centre and Ukraine's State Service of Special Communications and Information Protection. It includes training, exercises, knowledge exchange and secure information sharing related to cyber resilience.[185] This is particularly relevant for smart grids, AI-supported energy management systems and critical energy infrastructure protection.

Taken together, these agreements show that Sweden's role in relation to Ukraine is evolving from traditional donor support toward a long-term strategic partnership focused on resilience, innovation and future-oriented system transformation. Energy research and innovation therefore become central not only for reconstruction, but also for:

- resilient municipalities,
- digital infrastructure,
- cybersecurity,
- industrial competitiveness,
- sustainable housing,
- healthcare resilience,
- circular reconstruction,
- and future export capacity.

This creates a strong rationale for Sweden to structure its energy research and innovation cooperation with Ukraine in three interconnected layers:

1. integrating energy into existing Ukraine support programmes,
2. strengthening traditional energy research and innovation cooperation,
3. and exploring next-generation approaches focused on flourishing lives, resilient cities and human-centred energy systems.

183 Government Offices of Sweden. (2025). *Sweden and Ukraine deepen innovation and digitalisation cooperation*. https://www.government.se/press-releases/2025/11/sweden-and-ukraine-deepen-innovation-cooperation1/

184 Government Offices of Sweden. (2024). *Agreement on Security Cooperation between Sweden and Ukraine*. https://www.government.se/contentassets/c8a165d758854e9bbf622080aa7531e4/agreement-on-security-cooperation-between-sweden-and-ukraine-stockholm-31.05.2024.pdf

185 Government Offices of Sweden. (2026). *Sweden and Ukraine agree to cooperate on cybersecurity*. https://www.government.se/press-releases/2026/02/sweden-and-ukraine-agree-to-cooperate-on-cybersecurity/

**Table D.1. Key Sweden–Ukraine agreements and their relevance for research and innovation**

| Agreement / framework | Main focus | Relevance for research and innovation | Energy relevance |
|---|---|---|---|
| **Strategy for Sweden's reconstruction and reform cooperation with Ukraine 2023–2027** | Reconstruction, reform, EU integration | Supports innovation ecosystems, sustainable reconstruction, institutional capacity and private sector development | Strong focus on energy infrastructure, sustainable reconstruction and green transition |
| **MoU on Energy and Green Transition Partnership (2025)** | Energy cooperation and green transition | Enables joint pilots, research collaboration, knowledge exchange and innovation partnerships | Directly focused on energy systems, hydrogen, nuclear, renewables, district heating and energy efficiency |
| **LoI on Innovation and Digitalisation Cooperation (2025)** | Innovation, AI, digitalisation and industrial cooperation | Supports innovation ecosystems, AI, automation, semiconductors and digital transformation | Includes green transition, smart systems and digital energy solutions |
| **Agreement on Security Cooperation (2024)** | Long-term resilience and security cooperation | Links innovation, infrastructure protection, industrial cooperation and resilience | Critical infrastructure resilience, energy security and civil preparedness |
| **MoU on Cybersecurity Cooperation (2026)** | Cyber resilience and digital security | Supports cybersecurity competence, information sharing and digital resilience | Important for smart grids, digital energy systems and infrastructure protection |

The agreements collectively indicate that future Sweden–Ukraine cooperation will likely move beyond isolated projects toward integrated innovation missions that combine energy, digitalisation, resilience, security and human wellbeing. This also opens opportunities for Sweden to position itself as a strategic partner in developing next-generation resilient energy systems and sustainable cities together with Ukraine.

# 8. Global leadership through Ukraine-Sweden collaboration

**Summary**
Chapter 8 proposes a pathway for Ukraine and Sweden to lead in resilient, fossil-free and human-centred systems. Ukraine contributes learning under disruption, digital innovation, engineering and reconstruction environments; Sweden contributes welfare-state, innovation, export, municipal-governance and sustainability expertise. Beyond traditional development cooperation, joint work could create globally relevant responses to climate, geopolitical, energy-security and societal-resilience challenges while supporting Ukrainian reconstruction, EU integration and Swedish innovation.

Five potential domains are resilient distributed energy; AI-energy resilience and cybersecurity; human-centred reconstruction and energy services; sustainable decentralised bioenergy; and integrated energy resilience, preparedness, cybersecurity and defence innovation. These are opportunities, not established leadership positions.

**Conclusions for Energy Innovation**
Global relevance requires connecting research, demonstration, finance, implementation and export readiness. A proposed dual testbed combines Swedish validation and regulation with Ukrainian conditions of grid instability, attack, emergency operation and rapid restoration. Under the proposed approach, energy systems would be assessed through resilience, sustainability and outcomes including healthcare, warmth, housing and municipal services.

**Strategic Opportunities and Next Steps**
1. Bilateral instruments: Establish mission-oriented calls, a resilience innovation programme, clusters, municipal cooperation, mobility and expanded startup/investor platforms.
2. Dual testbed: Link Swedish validation with Ukrainian deployment in municipalities, hospitals, housing, heating, logistics, microgrids, AI-energy systems and biomethane.
3. Policy and investment: Combine rapid pilot funding and procurement with shared infrastructure, sandboxes, acceleration, blended/EU finance, investment funds and long-term coordination.
4. Roadmap: In 1-3 years establish pilots, calls, mobility and operating platforms; in 3-7 years scale clusters, demonstrators, finance and centres of excellence; in 8-20 years build permanent institutions and internationally transferable resilient-infrastructure models.

**Chapter Structure**
Section 8.1 identifies leadership domains.
Sections 8.2-8.4 propose instruments, a dual testbed and policy/investment measures.
Section 8.5 gives the roadmap.

The protection and reconstruction of Ukraine creates a historic opportunity not only to rebuild damaged infrastructure, but also to develop globally leading models for resilient, fossil-free and human-centred societies. Ukraine and Sweden together possess a unique combination of capabilities that few other bilateral partnerships can offer. Ukraine contributes real-world experience of resilience under extreme conditions, rapid digital innovation, strong engineering talent and large-scale reconstruction needs. Sweden contributes internationally recognised strengths in building a welfare state, a challenge driven innovation ecosystem, an export driven economy, municipal governance and sustainability transitions. [186,187]

Together, the two countries could position themselves as global leaders in innovation ecosystems delivering on human needs in ways that are globally sustainable. Such cooperation would not only support Ukraine's reconstruction and EU integration, but also shift Sweden's innovation ecosystem towards delivering on human needs, a new generation of industrial competitiveness and export capacity.

The opportunity is therefore broader than traditional development cooperation. It is the opportunity to jointly create globally relevant solutions for a century increasingly shaped by climate change, geopolitical instability, energy insecurity and the need for resilient societies that focus on the creation of new opportunities for self-realisation of citizens.

The experiences generated through Ukraine's reconstruction are likely to become increasingly valuable internationally as countries seek new approaches to resilience, preparedness and sustainable development.[188,189]

## 8.1. Areas for globally leading Sweden–Ukraine collaboration

Several thematic areas stand out where Sweden and Ukraine together could become internationally leading. These areas emerge from the overlap between Ukrainian reconstruction needs, Ukrainian technological strengths and Swedish system-level capabilities.

One of the clearest opportunities concerns resilient distributed energy systems. Ukraine's wartime experience has demonstrated the importance of decentralised, flexible and rapidly recoverable energy systems capable of operating under severe disruption. Sweden contributes advanced expertise in grid stability, district heating, energy planning, industrial energy systems and flexibility solutions. Together, the countries could develop globally

186 Government Offices of Sweden. (2023). *Strategy for Sweden's reconstruction and reform cooperation with Ukraine 2023–2027*. Government Offices of Sweden. https://www.government.se/contentassets/19d253702ff94665975da196bce2b879/strategy-for-swedens-reconstruction-and-reform-cooperation-with-ukraine-20232027.pdf

187 Government Offices of Sweden. (2025). *Sweden and Ukraine deepen innovation and digitalisation cooperation*. https://www.government.se/press-releases/2025/11/sweden-and-ukraine-deepen-innovation-cooperation1/

188 OECD. (2022). *Rebuilding Ukraine by reinforcing regional and municipal governance*. OECD Publishing. https://doi.org/10.1787/63a6b479-en

189 World Bank, European Commission, United Nations, & Government of Ukraine. (2024). *Ukraine rapid damage and needs assessment (RDNA4): February 2022–December 2024*. https://www.worldbank.org/en/country/ukraine/publication/rapid-damage-and-needs-assessment

leading approaches for resilient distributed systems, including microgrids, island operation, energy storage, hybrid heating systems and rapid restoration capabilities.[190,191,192]

A second area concerns AI-enabled energy resilience and cybersecurity. Ukraine has developed advanced digital governance and cybersecurity capabilities under wartime pressure, while Sweden has strong capabilities in industrial digitalisation, AI and energy systems optimisation. Joint work could establish international leadership in AI-supported energy planning, cybersecure smart grids, digital twins for infrastructure systems and automated resilience management.[190,193]

Sweden and Ukraine could also become global leaders in human-centred reconstruction and energy services. Rather than focusing only on energy supply or infrastructure replacement, the two countries could pioneer models where energy systems are explicitly designed to support societal outcomes such as comfort, healthcare, safety, accessibility and social resilience. This includes resilient systems for hospitals, rehabilitation centres, schools, housing and municipal services.[194]

Ukraine's agricultural capacity combined with Swedish expertise in bioenergy and circular industrial systems also creates strong opportunities in resilient decentralised bio energy system. Such systems must be globally sustainable and if they are they could contribute simultaneously to energy security, rural development and reduced import dependence.[191,194,195,196]

Finally, Sweden and Ukraine could jointly establish internationally relevant models where energy resilience, cybersecurity, civil preparedness and defence-related innovation are integrated into broader societal resilience systems. This may become one of the most strategically important innovation areas in Europe during the coming decades.[193]

190 Ministry of Climate and Enterprise of Sweden & Ministry of Energy of Ukraine. (2025). *Memorandum of Understanding on establishing an Energy and Green Transition Partnership in the field of Civil Nuclear Energy and the Green Transition*. Government Offices of Sweden.
https://www.regeringen.se/contentassets/e4c34a2604014ace803c56260f66d898/samforstandsavtalet-inom-energi-och-gron-omstallning-mellan-sverige-och-ukraina-mou.pdf
191 Swedish Energy Agency. (2024). *Strategic priorities in energy research and innovation 2025–2028: The Swedish Energy Agency's research and innovation commitments for a sustainable transition (ET 2024:01)*.
https://www.energimyndigheten.se/en/innovations-r--d/Our-strategic-priorities-in-energy-research-and-innovation/
192 International Energy Agency. (2024). *Empowering Ukraine through a decentralised electricity system*. IEA.
https://www.iea.org/reports/empowering-ukraine-through-a-decentralised-electricity-system
193 Ministry of Digital Transformation of Ukraine. (2025*). Sector strategy: Green technologies (GreenTech): Ukrainian Global Innovation Strategy until 2030*.
https://winwin.gov.ua/assets/files/ENG%20WINWIN_GreenTech.pdf
194 Pamlin, D., et al. (2025). *Energy innovation for the 21st and 22nd century.*
https://www.fl4all.world/publications/energy-innovation-for-the-21st-and-22nd-century
195 Food and Agriculture Organization of the United Nations (FAO). (2023). *Untapped bioenergy potential of Ukraine: Comprehensive view of proper use, issues of energy security and food security*. https://www.fao.org/platforms/green-agriculture/events/events-detail/untapped-bioenergy-potential-of-ukraine-comprehensive-view-of-proper-useissues-of-energy-securityand-food-security/en
196 International Energy Agency. (2026). *From farms to fuel: Ukraine's biomethane opportunity for energy security and European decarbonisation*. https://www.iea.org/commentaries/from-farms-to-fuel-ukraine-s-biomethane-opportunity-for-energy-security-and-european-decarbonisation

## 8.2. Bilateral research and innovation instruments

Realising this potential requires long-term bilateral instruments capable of connecting research, innovation, demonstration, financing and implementation. Existing cooperation mechanisms already provide a strong foundation, a Swedish Energy Agency pilot connects Swedish energy solutions with Ukraine's reconstruction, resilience and energy transition, but future collaboration will require more integrated and mission-oriented structures.[197,198]

Dedicated Sweden–Ukraine research calls should therefore be established around resilient fossil-free systems for reconstruction and EU integration. These calls should combine applied research, demonstration activities and implementation pathways rather than separating research from deployment. Priority areas could include distributed energy systems, district heating, AI and energy optimisation, storage technologies, municipal resilience, bio energy and cybersecure infrastructure.

A broader Sweden–Ukraine resilience innovation programme should also be developed. Such a programme would integrate research institutions, innovation agencies, municipalities, utilities, startups and industrial actors across the full innovation chain from early research to deployment and export readiness. This would help avoid fragmentation and strengthen long-term institutional cooperation.

Bilateral innovation clusters could further strengthen cooperation by connecting Swedish and Ukrainian actors around common strategic priorities. Universities, municipalities, government agencies, utilities, startups, industrial firms, investors and EU actors could participate in thematic clusters focused on resilient energy systems, AI-enabled infrastructure or human-centred reconstruction.[199,200]

Municipal cooperation should become a particularly important implementation mechanism. Swedish and Ukrainian municipalities could jointly develop and test solutions for housing, heating systems, public services, hospitals and urban resilience. Such cooperation would allow reconstruction challenges to be addressed through practical implementation environments while simultaneously strengthening long-term institutional relationships.[186]

Researcher mobility programmes also remain critical. Preserving Ukrainian scientific and innovation capacity while strengthening long-term institutional partnerships should be treated as a strategic priority. Joint doctoral programmes, visiting researcher programmes and institutional exchange mechanisms should therefore be expanded. [197,201]

197 Government Offices of Sweden. (2025). *Sweden is a founding member of the initiative Coalition for Science, Research and Innovation in Ukraine*. https://www.government.se/press-releases/2025/07/sweden-is-a-founding-member-of-the-initiative-coalition-for-science-research-and-innovation-in-ukraine/

198 Swedish Energy Agency. (2026). *Pilotsatsning där svenska företag kan stötta Ukraina*. https://www.energimyndigheten.se/nyhetsarkiv/2026/pilotsatsning-dar-svenska-foretag-kan-stotta-ukraina

199 European Commission. (2024). *Ukraine Facility*. https://enlargement.ec.europa.eu/funding-technical-assistance/ukraine-facility_en

200 Mazzucato, M. (2018). *Mission-oriented research & innovation in the European Union: A problem-solving approach to fuel innovation-led growth*. European Commission, Directorate-General for Research and Innovation. https://doi.org/10.2777/360325

201 European Commission. (2024). *MSCA4Ukraine: Standing with Ukraine's research community*. https://marie-sklodowska-curie-actions.ec.europa.eu/node/1247

Existing platforms such as InnovationBridge, TechStep and related innovation mechanisms could also be expanded to include energy resilience, AI, cybersecurity and reconstruction-focused innovation. Bilateral startup acceleration programmes and investor platforms could support scaling of Swedish–Ukrainian innovation partnerships and strengthen future export opportunities.[187,202,203]

## 8.3. Ukraine-Sweden dual testbed and demonstration model

One opportunity for global leadership lies in combining Swedish and Ukrainian test environments into a shared dual testbed model. Sweden provides stable infrastructure, systems integration expertise, industrial collaboration, regulatory capacity and advanced testing methodologies. Ukraine provides real-world resilience conditions, rapid deployment environments and operational learning under extreme stress conditions.[189]

Together, this creates a unique full-spectrum innovation environment ranging from laboratory validation to real-world deployment under disruption. Sweden can function as an environment for systems integration, district heating optimisation, industrial symbiosis, long-term energy optimisation, regulatory testing and sustainable urban development. Swedish cities, research institutes and industrial clusters can provide structured environments for validating technologies before deployment at larger scale.[190]

Ukraine, in turn, can function as a globally unique resilience innovation environment where technologies and systems are tested under real-world conditions involving grid instability, infrastructure attacks, emergency operations and rapid restoration needs. This creates learning environments that are increasingly relevant for Europe and other regions facing growing climate risks, infrastructure vulnerabilities and geopolitical instability.[189,204,205]

Joint demonstration platforms should therefore be established around resilient municipalities, hospitals and rehabilitation systems, housing reconstruction, district heating, ports and logistics, AI-enabled energy systems, microgrids, backup systems and biomethane infrastructure. These demonstration environments should be directly connected to research programmes, investors, industrial actors and EU financing mechanisms in order to accelerate scaling and implementation.[190,198]

## 8.4. Policy and investment measures

Achieving global leadership requires more than individual projects or research programmes. It requires long-term policy alignment, financing mechanisms and ecosystem development capable of supporting transformation at scale.[200,206]

202 Swedish Institute. (2025). *SI Ukraine Cooperation Programme*. https://si.se/siucp

203 National Board of Trade Sweden. (2025). *TechStep Sweden*. https://www.kommerskollegium.se/en/import--export/firms-in-developing-countries-wanting-to-export-to-sweden/assisting-exporters---open-trade-gate-sweden/techstep-sweden/

204 OECD. (2022). *Building back a better innovation ecosystem in Ukraine*. OECD Publishing. https://doi.org/10.1787/85a624f6-en

205 European Network of Living Labs. (n.d.). *The world of Living Labs*. https://enoll.org/living-labs/

206 European Investment Bank. (2024). *United in Ukraine's recovery: EC-EIB-UNDP partnership is driving reconstruction and building resilience*. https://www.eib.org/en/press/news/united-in-ukraine-s-recovery-ec-eib-undp-partnership-is-driving-reconstruction-and-building-resilience

In the short term, Sweden and Ukraine should prioritise rapid and flexible support mechanisms capable of accelerating implementation. This includes fast-track pilot funding, simplified bilateral financing structures, rapid deployment support, innovation procurement, municipal support mechanisms and emergency innovation financing. Researcher mobility and institutional continuity should also remain priorities in order to preserve scientific capacity and long-term cooperation potential.[197,201]

Over the medium term, the focus should increasingly shift toward ecosystem development and institutional integration. Bilateral innovation platforms, coordinated cluster development, shared research infrastructures, regulatory sandboxes and startup acceleration mechanisms should therefore be expanded. Municipal innovation networks and public-private partnerships will also become increasingly important as reconstruction moves from emergency response toward systems transformation and EU integration.[204,206]

Long-term leadership will require permanent institutional structures capable of supporting integrated resilience and innovation ecosystems. This includes permanent Sweden–Ukraine innovation platforms, blended public-private financing structures, resilience investment funds and internationally recognised centres of excellence. Such structures could support globally competitive export ecosystems while strengthening both Ukrainian reconstruction and Swedish industrial competitiveness.

Investment mobilisation will be particularly important. Public funding alone will not be sufficient to support the scale of transformation required. Sweden and Ukraine should therefore develop mechanisms for blended finance, EU financing integration, venture capital mobilisation, municipal financing platforms and industrial co-investment models.

A recurring challenge identified throughout the report is fragmentation between actors, sectors and funding streams. Effective governance and coordination mechanisms will therefore be essential. Sweden and Ukraine should establish coordinating structures capable of linking ministries, municipalities, research institutions, innovation agencies, investors, companies, utilities, EU actors and development banks around shared long-term missions.[200,206]

Financing should also function as a directional instrument for reconstruction and innovation. The Environmental Compact recommends common sustainability principles for reconstruction finance, including avoidance of significant environmental harm, assessment of material climate and biodiversity effects, and proportionate independent verification.[207]

Sweden–Ukraine programmes could apply these principles through project-selection criteria covering human outcomes, resilience, environmental performance, scalability, transparency and implementation capacity.

207 High-Level Working Group on the Environmental Consequences of the War. (2024). *An environmental compact for Ukraine: A green future—Recommendations for accountability and recovery*. European Institute of Peace. https://www.eip.org/publication/an-environmental-compact-for-ukraine

## 8.5. Short-, medium- and long-term roadmap

In the short term, covering approximately one to three years, the immediate priority should be to strengthen resilience, preserve research capacity and establish bilateral operational structures. Sweden and Ukraine should launch bilateral pilot and demonstration programmes, establish joint research calls, support researcher mobility, strengthen municipal cooperation and identify priority sectors and demonstration environments. The immediate goal should be to create functioning cooperation platforms while simultaneously supporting urgent reconstruction and resilience needs.[187,200]

Over the medium term, covering approximately three to seven years, the focus should increasingly shift toward scaling innovation ecosystems and integrating demonstration results into larger systems transformation processes. Bilateral innovation clusters should be expanded, demonstration environments scaled and joint centres of excellence established. Regulatory sandboxes, startup ecosystems and integrated financing mechanisms should also be strengthened during this phase. The objective should be to create internationally recognised resilience innovation ecosystems capable of attracting investment, talent and industrial cooperation.[205,207]

In the long term, covering approximately eight to twenty years, the objective should be to position Sweden and Ukraine as global leaders in resilient and human-centred infrastructure systems. This would involve establishing globally recognised resilience innovation clusters, integrating reconstruction and export strategies, scaling resilient infrastructure models internationally and creating permanent bilateral institutions for long-term cooperation. Over time, Ukraine and Sweden could jointly help shape internationally relevant models for how future societies combine resilience, sustainability, security and flourishing lives on a flourishing planet.

# 9. Possible structure for research- and innovation collaboration between Ukraine-Sweden

**Summary**
Chapter 9 proposes Swedish-Ukrainian R&I cooperation moving from emergency reconstruction towards resilient, fossil-free and human-needs-driven energy systems. Energy is framed not only as supply, but as a foundation for health, comfort, education, safety and flourishing lives. Existing bilateral agreements provide a strategic basis for establishing the chapter's proposed three-portfolio cooperation model.

Reconstruction and innovation should be integrated. Cooperation should use mutual learning and co-development: Sweden contributes institutional, municipal, heating, industrial-transition and governance strengths; Ukraine contributes operational resilience experience. Success should include service continuity, affordability, accessibility, wellbeing and export capacity, not only infrastructure and emissions.

**Conclusions for Energy Innovation**
Energy should be cross-cutting across support programmes, conventional R&I and next-generation reconstruction. Themes include municipal resilience; digital energy, AI and cybersecurity; buildings and district heating; grids, storage and flexibility; green entrepreneurship; and inclusive innovation. Pilots, calls and clusters should connect technology to human outcomes and link emergency aid, deployment, research and EU investment.

**Strategic Opportunities and Next Steps**
1. Portfolio 1 – proposed guidance: Create Ukraine Energy Innovation Guidance and use existing programmes for pilots, a short research call and a municipal energy cluster.
2. Portfolio 2 – proposed R&I track: Link Swedish energy priorities to Ukrainian test environments through demonstrations, a resilient fossil-free systems call and a bilateral cluster.
3. Portfolio 3 – proposed flagship: Explore a Superhumans-linked Flourishing City Mission integrating accessible housing, rehabilitation, resilient energy, mobility, digital services, circular construction, jobs and universal design.
4. Proposed implementation: Select a location and mission, build a delivery consortium, launch pilots, then produce replicable guidance, procurement, finance, standards, training and export packages measured through improved lives.

**Chapter Structure**
Sections 9.1-9.3 develop the portfolios. The details of each part are found in supplemental Appendix R7 (separate document).
Section 9.4 consolidates them and explains the human-needs, mutual-learning and flourishing-life rationale.

Sweden has a unique opportunity to collaborate with Ukraine to move beyond emergency reconstruction toward a new generation of innovation that supports resilient societies, flourishing lives and long-term prosperity that deliver on human needs, as per the goals in the Ukrainian innovation strategy. This requires a shift from viewing innovation as a matter of moving up the TRL scale for different technologies, i.e. not view energy research and innovation primarily as new solutions for electricity supply, distribution and storage, but approach energy as a foundational system for delivering human wellbeing, resilience, security and future societal development. [208,209]

The ongoing urgent reconstruction of Ukraine coincides with a broader global transition in research, innovation, and energy thinking. Traditional energy systems in the 20th century were primarily designed around fuel extraction, electricity production and industrial growth. However, emerging energy innovation frameworks increasingly focus on how energy systems support concrete human outcomes such as thermal comfort, health, mobility, education, communication, safety, social participation and flourishing lives. [210] In this perspective, energy becomes a means to deliver societal outcomes rather than an end in itself.

This shift is particularly relevant in Ukraine. The war has demonstrated that resilient energy systems are not only critical for economic activity, but also for hospitals, rehabilitation centres, schools, water systems, food systems, communication, democratic resilience and everyday survival.[211,212,213] Ukraine's reconstruction therefore creates an opportunity not simply to rebuild a fossil free version of the old infrastructure, but to develop globally relevant models for resilient and human-centred energy systems. [214]

At the same time, global sustainability discussions are increasingly moving beyond the Sustainable Development Goals (SDGs) toward a post-SDG agenda with a focus on wellbeing, resilience and flourishing lives on a flourishing planet.[215] A flourishing-life perspective highlights that future climate innovation should not only reduce emissions, but also improve people's lives through better housing, health, mobility, access, comfort, participation and meaningful opportunities. Ukraine's reconstruction could therefore

208 Pamlin, D., et al. (2025). *Energy innovation for the 21st and 22nd century*.
https://www.fl4all.world/publications/energy-innovation-for-the-21st-and-22nd-century
209 Pamlin, D., et al. (2026). F*lourishing Lives on a Flourishing Planet*. https://www.fl4all.world/publications/flourishing-lives-on-a-flourishing-planet
210 Government Offices of Sweden. (2025). *Sweden and Ukraine deepen innovation and digitalisation cooperation*.
https://www.government.se/press-releases/2025/11/sweden-and-ukraine-deepen-innovation-cooperation1/
211 International Energy Agency. (2024). *Ukraine's energy security and the coming winter: An energy action plan for Ukraine and its partners*. IEA.
https://www.iea.org/reports/ukraines-energy-security-and-the-coming-winter
212 Food and Agriculture Organization of the United Nations. (2024). *In total, FAO will provide 245 generators to Ukrainian food producers*.
https://www.fao.org/countryprofiles/news-archive/detail-news/en/c/1708166
213 Romanyshyn, I. (2023, April 4). *Ukraine's total democratic resilience in the shadow of Russia's war*. Carnegie Europe.
https://carnegieendowment.org/research/2023/04/ukraines-total-democratic-resilience-in-the-shadow-of-russias-war
214 Ministry of Digital Transformation of Ukraine. (2025*). Sector strategy: Green technologies (GreenTech): Ukrainian Global Innovation Strategy until 2030*.
https://winwin.gov.ua/assets/files/ENG%20WINWIN_GreenTech.pdf
215 United Nations Development Programme. (2024). *Human development report 2023–24: Breaking the gridlock: Reimagining cooperation in a polarized world*. UNDP.
https://hdr.undp.org/content/human-development-report-2023-24

become a strategic arena for developing a new generation of energy innovation focused on flourishing lives on a flourishing planet.

Sweden is well positioned to contribute to this transformation with Ukraine. Sweden combines strong capabilities in: energy systems, district heating, digitalisation, sustainable urban development, industrial transition, innovation systems, welfare systems, and mission-oriented research and innovation.

Sweden's reconstruction and reform strategy for Ukraine emphasises sustainable reconstruction, resilience, reform and EU integration as mutually reinforcing objectives, with a total strategy envelope of SEK 9 billion for 2023–2027. [216] The Ukraine-Sweden Energy and Green Transition Partnership establishes cooperation around energy systems, resilience, green transition and civil nuclear cooperation. [217] The Ukraine-Sweden innovation cooperation agreement expands the agenda toward AI, digitalisation, cybersecurity and innovation ecosystems. [218]

Together, these agreements create a strategic framework where energy research and innovation become part of a broader resilience and reconstruction agenda linked to security, digitalisation, industrial development and long-term societal transformation.[219]

Sweden would benefit from structuring its support around one shared mission: to work with Ukraine to move from emergency energy support and reconstruction toward resilient, fossil-free and human-needs-driven energy systems that can improve daily life, strengthen security and create future Ukrainian and Swedish export capacity.[210,216,217]

216 Government Offices of Sweden. (2023). *Strategy for Sweden's reconstruction and reform cooperation with Ukraine 2023–2027*. Government Offices of Sweden.
https://www.government.se/contentassets/19d253702ff94665975da196bce2b879/strategy-for-swedens-reconstruction-and-reform-cooperation-with-ukraine-20232027.pdf
217 Ministry of Climate and Enterprise of Sweden & Ministry of Energy of Ukraine. (2025). *Memorandum of Understanding on establishing an Energy and Green Transition Partnership in the field of Civil Nuclear Energy and the Green Transition*. Government Offices of Sweden.
https://www.regeringen.se/contentassets/e4c34a2604014ace803c56260f66d898/samforstandsavtalet-inom-energi-och-gron-omstallning-mellan-sverige-och-ukraina-mou.pdf
218 Government Offices of Sweden. (2024). *Agreement on Security Cooperation between Sweden and Ukraine*.
https://www.government.se/contentassets/c8a165d758854e9bbf622080aa7531e4/agreement-on-security-cooperation-between-sweden-and-ukraine-stockholm-31.05.2024.pdf
219 Government Offices of Sweden. (2026). *Sweden and Ukraine agree to cooperate on cybersecurity*.
https://www.government.se/press-releases/2026/02/sweden-and-ukraine-agree-to-cooperate-on-cybersecurity/

## 9.1. PART 1. Strengthen support for Ukraine and integrate resilient energy support that deliver on human needs

Sweden could use existing Ukraine support instruments, such as the SI Ukraine Cooperation Programme and TechStep Sweden, as entry points for a broader energy-relevant innovation agenda. [220,221] These programmes already support reconstruction, reform, innovation ecosystems, digital transformation, entrepreneurship and Ukrainian-Swedish collaboration, but energy is not yet sufficiently explicit as a strategic priority.

A suggestion is therefore to develop a Ukraine Energy Innovation Guidance (U-EIG) for all relevant stakeholders that aligns with Ukraine's GreenTech sector strategy, which identifies strengths in wind, solar, bioenergy, nuclear competence, EU cooperation and IT capacity, but weaknesses in manual dispatching, low household incentives, import dependence and outdated building networks. [222]

The UEI should clarify that energy-relevant projects should when possible prioritise:

1. Link to human needs
2. Support for resilient local energy systems,
3. energy-efficient reconstruction that is compatible with a future where 8-12 billion people live flourishing lives on a flourishing planet,
4. digital energy services that are based on protected data and that follow cyber security standards
5. Build on AI for energy security that delivers on human needs,
6. When bioenergy is used ensure that it is globally sustainable supply chains and amounts per service provided.
7. Focus on innovations delivering on human needs, including energy solutions for hospitals, schools, housing and municipalities.

Further details are found in supplemental Appendix R7.

## 9.2. PART 2. Support traditional energy research and innovation work and link them to human needs

Sweden could align Ukraine cooperation with the Swedish Energy Agency's existing research and innovation priorities while adapting them to Ukraine's specific needs: energy security, fossil-free energy, flexibility, heating, electricity grids, industrial transition, buildings, transport, bioenergy, storage, and digitalisation. [223]

220 Swedish Institute. (2025). *SI Ukraine Cooperation Programme*. https://si.se/siucp

221 National Board of Trade Sweden. (2025). *TechStep Sweden*. https://www.kommerskollegium.se/en/import--export/firms-in-developing-countries-wanting-to-export-to-sweden/assisting-exporters---open-trade-gate-sweden/techstep-sweden/

222 Ministry of Digital Transformation of Ukraine. (2025*). Sector strategy: Green technologies (GreenTech): Ukrainian Global Innovation Strategy until 2030*.
https://winwin.gov.ua/assets/files/ENG%20WINWIN_GreenTech.pdf

223 Swedish Energy Agency. (2024). *Strategic priorities in energy research and innovation 2025–2028: The Swedish Energy Agency's research and innovation commitments for a sustainable transition (ET 2024:01)*.
https://www.energimyndigheten.se/en/innovations-r--d/Our-strategic-priorities-in-energy-research-and-innovation/

The Swedish Energy Agency's 2026 pilot initiative is already designed to help Swedish companies introduce solutions to the Ukrainian market and contribute to Ukraine's reconstruction, resilience and transition.[224] This should be complemented by a dedicated research and innovation track linking Swedish energy research to Ukrainian test environments.

Further details are found in supplemental Appendix R7.

## 9.3. PART 3. Explore the next generation of research and innovation work for reconstruction

The situation in Ukraine can be seen an opportunity to not only to rebuild, but to develop globally relevant models for resilient and human-centred urban systems.[222]

Ukraine and Sweden could launch an ambitious future-oriented initiative together: a Flourishing City Reconstruction Mission. The purpose would be to support the design and construction of a new city, or a radically renewed city district, in Ukraine. This need a leading innovation ecosystem, such as the one around the Superhumans Center in Ukraine.[225]

Superhumans is one of Ukraine's most important examples of human-centred reconstruction innovation. It is a nationwide modern centre for war trauma that provides prosthetics, reconstructive surgery, rehabilitation, psychological support, hearing restoration, peer-to-peer support, and social reintegration for adults and children affected by the war. Its services are free of charge, and the organisation reports more than 2,500 patients, 2,600 prosthetics, 2,000 surgeries, and a goal of three centres in Ukraine by the end of 2026.

This makes Superhumans much more than a healthcare provider. It is an ecosystem built during a war for restoring people's ability to live, work, move, participate and contribute again. A new city or district built around this ecosystem could become a global demonstration of how reconstruction after catastrophic disruptions can move beyond repairing damage and instead create the next generation of inclusive, resilient and flourishing urban systems.

A reconstruction for flourishing should not only rebuild what was lost. It should build a new system that allow people need to live flourishing lives. This approach would be relevant not only for Ukraine. It could later be replicated in other disrupted contexts, including places affected by war, earthquakes, floods, climate disasters or political collapse. The framework could therefore become a practical model for how cities can turn destruction into leapfrogging opportunities: moving directly toward better energy systems, better healthcare, better housing, better mobility, better social inclusion and better local economies than existed before.

224 Swedish Energy Agency. (2026). *Pilotsatsning där svenska företag kan stötta Ukraina*. https://www.energimyndigheten.se/nyhetsarkiv/2026/pilotsatsning-dar-svenska-foretag-kan-stotta-ukraina

225 Superhumans Center. (n.d.). *Superhumans Center: We return the super opportunities to Ukrainians*. https://superhumans.com

A Flourishing City Reconstruction Mission would start from a different question than most reconstruction projects. Instead of asking "How do we rebuild infrastructure?", it would be a response to the goal in Ukraine's innovation strategy, i.e. how to we increase living standards and create new opportunities for self-realisation of citizens. [226]

This question changes the traditional aid, response, and design logic:

- Housing would not only need to be affordable, accessible and extremely energy/resource efficient, it also needs to be a place where people can flourish though art, science, physical activity and social interactions.
- Streets and public spaces would need to support people using prosthetics, wheelchairs, mobility aids and assistive technologies.
- Pre-emptive and traditional healthcare would need to be close to daily life rather than isolated in hospitals.
- Rehabilitation would need to be connected to work, education, sport, culture and social participation.
- Energy systems would need to guarantee heat, electricity and digital connectivity even during disruption.
- Digital services would need to make support easy to access.
- Businesses would need to create meaningful employment, including for veterans, injured civilians, caregivers and displaced people.

This means the city should not be designed as a conventional "smart city." It should be designed as a flourishing city: a place where technology, energy, healthcare, housing and public services are organised around human capabilities and daily life.

The mission should be based on the idea that disruption can become a leapfrogging opportunity when reconstruction is guided by future needs rather than past systems. After wars or disasters, the normal pressure is to rebuild quickly. That is necessary, but it can also create long-term lock-in. If damaged buildings, energy systems, roads and institutions are replaced with slightly updated versions of the old systems, the result may be faster recovery but not real transformation. Academic literature on "build back better" highlights that reconstruction should reduce future risk and improve long-term resilience, not simply replace what was destroyed.[227,228]

Work on post-conflict reconstruction also shows that recovery often fails when it treats cities mainly as physical infrastructure rather than as social, institutional and human systems.[229,230]

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226 Ministry of Digital Transformation of Ukraine. (2024). *WINWIN: Ukraine's global innovation strategy*. https://winwin.gov.ua/assets/files/WINWIN_Main%20Presentation.pdf

227 Fernandez, G., & Ahmed, I. (2019*). "Build back better" approach to disaster recovery: Research trends since 2006*. Progress in Disaster Science, 1, Article 100003. https://doi.org/10.1016/j.pdisas.2019.100003

228 Zhou, B., Zhang, H., & Evans, R. (2022). *Build back better: A framework for sustainable recovery assessment*. International Journal of Disaster Risk Reduction, 76, Article 102998. https://doi.org/10.1016/j.ijdrr.2022.102998

229 Martinović, A., & Ifko, S. (2018). *Industrial heritage as a catalyst for urban regeneration in post-conflict cities: Case study: Mostar, Bosnia and Herzegovina*. Cities, 74, 259–268. https://doi.org/10.1016/j.cities.2017.12.013

230 Dimelli, D., & Kotsoni, A. (2023). *The reconstruction of post-war cities: Proposing integrated conservation plans for Aleppo's reconstruction*. Sustainability, 15(6), Article 5472. https://doi.org/10.3390/su15065472

For Ukraine, this is especially important. The war has created enormous human suffering, but it has also accelerated innovation in rehabilitation, digital governance, drones, logistics, cyber resilience, distributed infrastructure and emergency response. The question is how these capabilities can be redirected into civilian reconstruction and long-term flourishing. A new city or district around Superhumans could become a practical answer.

It could show how Ukraine can move from war-driven innovation to peace-oriented system innovation. It could also show how Sweden and Ukraine together can create a model for reconstruction that is useful for other countries facing major disruptions.

Further details are found in supplemental Appendix R7.

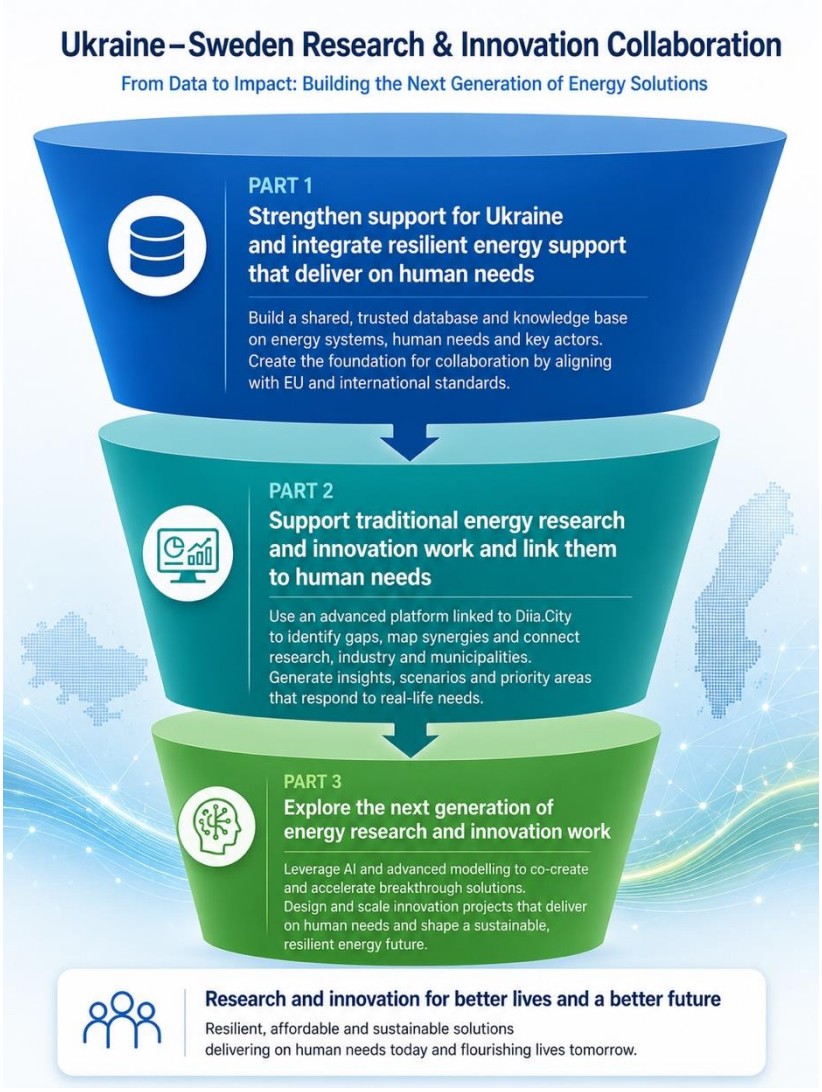
## 9.4. Possible overall structure

Sweden could organise the work through three interconnected portfolios:

1. **Energy guidance for all Ukraine support**
   Ensure research and innovation coordination in different initiatives that has research and innovation component, and especially when they relate to infrastructure and governance. This include future initiatives such as SI, TechStep, InnovationBridge and similar programmes.

2. **Traditional energy R&I for reconstruction and resilience**
   Use the Swedish Energy Agency, RISE, Swedish companies and Ukrainian partners to develop pilots, research calls and innovation clusters around resilient fossil-free systems.

3. **Next-generation flourishing city mission**
   Build a flagship Sweden–Ukraine initiative integrating energy, health, ageing, rehabilitation, mobility, digital systems and export capacity.



The core message is that Sweden and Ukraine could collaborate to rebuild energy systems that do more than restore current capacities. The collaboration could provide secure, affordable and fossil-free foundations for flourishing lives while simultaneously creating new innovation and export opportunities for Ukraine and Europe.

A central insight emerging from the broader analysis is that reconstruction and innovation should not be treated as separate processes. In many historical reconstruction efforts, infrastructure has primarily been rebuilt to restore previous economic functions as quickly as possible. However, Ukraine's current situation creates conditions where reconstruction can simultaneously become a platform for long-term transformation.

This is particularly important in the energy sector. Traditional energy-policy frameworks often evaluate success based on installed generation capacity, infrastructure repair, or fuel replacement. While these dimensions remain important, they are insufficient for evaluating whether reconstruction contributes to resilient and flourishing societies.

A human-needs-oriented perspective instead evaluates how energy systems contribute to daily life and societal resilience.

Questions therefore shift toward:

- whether schools remain operational during disruption,
- whether hospitals can maintain care capacity,
- whether households can maintain safe indoor temperatures,
- whether elderly and vulnerable populations can access services,
- whether digital systems continue functioning,
- and whether local economies can sustain meaningful activity.

This perspective is increasingly relevant globally as sustainability discussions move beyond purely emissions-oriented frameworks toward broader wellbeing and flourishing perspectives.

Ukraine should not only be understood as a recipient of aid or reconstruction support. The country is increasingly becoming one of the world's most important real-world environments for resilience innovation.

During wartime, Ukrainian actors have demonstrated extraordinary capacities in: Rapid digital deployment, distributed infrastructure management, emergency logistics, cybersecurity, adaptive governance, decentralised problem-solving, and cross-sector innovation.

These experiences have major international relevance. Future climate-related disruptions, cyber threats, energy-system vulnerabilities, and geopolitical instability are likely to affect many countries. Lessons from Ukraine may therefore become highly valuable for Europe and other regions.

Swedish cooperation frameworks should consequently be designed around mutual learning and co-development rather than one-directional transfer models. Sweden contributes

strong institutional capacity, municipal systems expertise, district heating experience, industrial transition knowledge, and long-term innovation governance. Ukraine contributes operational resilience experience under extreme stress conditions.

An important emerging dimension within sustainability discussions concerns the transition beyond traditional SDG implementation toward broader flourishing-life frameworks. Such approaches emphasise that future societies must not only reduce environmental harm but also actively support meaningful, healthy, resilient, and socially connected lives within planetary boundaries.

In practical terms, this means that reconstruction and innovation policies increasingly should consider: wellbeing, mental health, participation, social cohesion, accessibility, quality of life, contribution capacity, and long-term human development.

Ukraine's reconstruction creates a rare opportunity to explore how future urban systems, energy systems, healthcare systems, digital systems, and mobility systems can be designed together around these broader societal goals.

For Sweden, this also creates opportunities to position itself internationally as a leader in mission-oriented innovation focused not only on decarbonisation, but also on flourishing lives on a flourishing planet.

# 10. Synergy and Acceleration Frameworks for Ukraine–Sweden Research and Innovation Cooperation

**Summary**
Chapter 10 proposes Synergy and Acceleration Frameworks for Swedish-Ukrainian R&I. Ukraine does not primarily lack initiatives or actors; the challenge is coordination, alignment, integration and acceleration amid reconstruction, EU integration, digital transformation, security pressures and climate transition.

Fragmentation risks duplication, isolated pilots, weak learning, missed synergies, underused data and poor links between local needs and international support. Ukrainian digital platforms enable stronger innovation governance; Sweden contributes mission-oriented innovation, digitalisation, energy, municipal governance and public-private collaboration.

**Conclusions for Energy Innovation**
Energy and resilience projects would be assessed as connected portfolios rather than isolated technologies. Coordination should identify overlaps, gaps, scaling opportunities and links to Ukrainian priorities and EU programmes. The approach seeks to connect investment with resilience, climate performance, wellbeing, security and flourishing lives within planetary boundaries.

**Strategic Opportunities and Next Steps**

1. SAF-MRII – proposed lightweight framework: Help smaller initiatives record needs, alignment, status, outcomes, scaling potential, risks and support requirements.
2. SAF-STEMRII – proposed portfolio framework: Use AI, expert assessment and current priorities to coordinate complex ecosystems, identify synergies and gaps, accelerate implementation and strengthen learning.
3. SAF-FLAGRII – proposed flagship framework: Support major transformation missions through AI-enabled governance, foresight, resilience and societal-impact assessment linked to Ukraine's digital ecosystem and strategy.
4. Proposed progression: Enable small projects to become scalable initiatives, scalable initiatives to form strategic portfolios, and portfolios to contribute to flagship reconstruction and innovation missions.

**Chapter Structure**
After the shared rationale, Sections 10.1-10.3 propose the three frameworks at increasing levels of complexity and integration. Further details are found in supplemental Appendix R8.

One of the central findings of the broader analysis in this report is that Ukraine's reconstruction and transformation challenge is not primarily a lack of initiatives, projects or actors. On the contrary, Ukraine is currently one of the most dynamic innovation environments in Europe, with a rapidly expanding ecosystem involving ministries, municipalities, startups, universities, civil society organisations, international donors, investors and international research and innovation partners. The challenge is increasingly one of coordination, strategic alignment, system integration and acceleration.

This challenge is amplified by the speed and scale of reconstruction needs. Ukraine simultaneously faces:

- emergency reconstruction needs,
- long-term infrastructure transformation,
- EU integration,
- digital transformation,
- defence-related innovation pressures,
- climate and energy transition,
- demographic pressures,
- and the need to create future economic competitiveness and flourishing lives.

Under these conditions, fragmented innovation systems create significant risks:

- duplication of efforts,
- isolated pilot projects,
- weak learning across initiatives,
- missed synergies,
- underutilised data,
- short-term project logic,
- and insufficient connection between local needs and international support.

At the same time, Ukraine has unique opportunities. Through platforms such as Diia, DREAM and the emerging WINWIN 2030/2035/2039 frameworks, Ukraine is becoming one of the world's leading environments for digital governance, adaptive public administration and innovation-oriented reconstruction.[231,232]] This creates possibilities not only for better project coordination, but also for developing next-generation approaches to innovation governance, resilience planning and mission-oriented transformation.

Sweden is particularly well positioned to support such an approach. Sweden combines strong capabilities in: mission-oriented innovation, public-sector digitalisation, energy systems, municipal governance, innovation ecosystem, public-private collaboration, and research-based policy development.

The proposed Synergy and Acceleration Frameworks are therefore designed not simply as administrative databases, but as enabling infrastructures for long-term transformation cooperation between Ukraine and Sweden.

231 Ministry of Digital Transformation of Ukraine. (2024). *Transforming Reality*. [Translated] https://thedigital.gov.ua/ministry

232 DREAM Project Office. (2024). *Public Investment Management System*. [Translated] Digital Restoration Ecosystem for Accountable Management (DREAM). https://dream.gov.ua

The overall purpose of the frameworks is to:

- support Ukrainian priorities,
- reduce fragmentation,
- accelerate implementation,
- identify synergies and gaps,
- strengthen learning across initiatives,
- improve strategic alignment,
- and increase the long-term societal impact of research and innovation investments.

The frameworks are structured into three categories corresponding to different levels of complexity, strategic importance and institutional integration:

A. SAF-MRII
   A lightweight and accessible framework for smaller initiatives and projects.
B. AF-STEMRII
   A more advanced AI-supported portfolio and acceleration framework for research and innovation ecosystems, initially focused on areas such as energy, climate and resilience.
C. AF-FLAGRII
   A flagship-level AI-driven transformation platform integrated into Ukraine's broader digital and innovation ecosystem and supporting global leadership around flourishing lives on a flourishing planet.

Together, the three frameworks form a progressive architecture where:

- smaller projects can become scalable initiatives,
- scalable initiatives can evolve into strategic portfolios,
- and strategic portfolios can contribute to flagship transformation missions linked to Ukraine's long-term innovation and reconstruction strategy.

Importantly, the frameworks are not only intended to improve efficiency. They are also designed to help shift innovation systems from isolated technology deployment toward broader societal outcomes linked to resilience, human wellbeing, security and flourishing lives within planetary boundaries.[233,234]

233 Pamlin, D., et al. (2025). *Energy innovation for the 21st and 22nd century*. https://www.fl4all.world/publications/energy-innovation-for-the-21st-and-22nd-century

234 Pamlin, D., et al. (2026). F*lourishing Lives on a Flourishing Planet*. https://www.fl4all.world/publications/flourishing-lives-on-a-flourishing-planet

# Synergy and Acceleration Frameworks
## for Ukraine–Sweden Research and Innovation Cooperation

THREE LINKED FRAMEWORKS – ONE CONTINUOUS JOURNEY

## A SAF-MRII
**Minimum Requirements Innovation & Impact Framework**

A lightweight and accessible framework for smaller initiatives and projects.

**PURPOSE**

Provide a simple, practical structure to ensure quality, relevance and impact in smaller research and innovation collaborations.

**KEY ELEMENTS**

- Clear Objective
- Partners & Roles
- Work Plan & Deliverables
- Impact & Indicators
- Risk & Compliance

**OUTPUTS**

Well-designed projects with clear impact pathways and easy reporting.

**IDEAL FOR**

Pilot projects, feasibility studies, capacity building, student exchanges, workshops, short-term initiatives.

## B SAF-STEMRII
**Strategic Portfolio, Tracking, Evaluation & Matching for Research and Innovation Impact**

A more advanced AI-supported portfolio and acceleration framework for research and innovation ecosystems, focused on energy, climate and resilience.

**PURPOSE**

Optimize portfolios, identify synergies and gaps, accelerate impact and steer resources to the areas with highest value and mission alignment.

**KEY CAPABILITIES**

- AI-driven Matching
- Synergy & Gap Analysis
- Portfolio Analytics
- Impact Scoring
- Adaptive Management

**OUTPUTS**

Data-driven decisions, optimized portfolios, stronger synergies and faster time-to-impact.

**IDEAL FOR**

Thematic programs, multi-partner consortia, regional initiatives, energy & climate innovation clusters.

## C SAF-FLAGRII
**Flagship-Level AI-driven Global Leadership for Research and Innovation Impact**

A flagship-level AI-driven transformation platform integrated into Ukraine's broader digital and innovation ecosystem and supporting global leadership around flourishing lives on a flourishing planet.

**PURPOSE**

Drive systemic transformation at scale, link across sectors and borders, and shape global agendas for a sustainable and flourishing future.

**CORE CAPABILITIES**

- Generative AI Platform
- Cross-Sector & Cross-Border Integration
- Scenario & System Modeling
- Global Stakeholder Engagement
- Mission Impact Acceleration

**OUTPUTS**

Transformative solutions, global influence, and long-term systems impact.

**IDEAL FOR**

Flagship missions, large-scale transformation programs, global partnerships, policy-shaping initiatives.

## CROSS-CUTTING ENABLERS ACROSS ALL FRAMEWORKS

- Trust & Mutual Understanding
- Data Security & Ethics
- Open Standards & Interoperability
- Talent & Capacity Building
- Inclusive & Ethical Governance
- Sustainable Funding & Resources
- Communication & Knowledge Sharing

**RESEARCH AND INNOVATION FOR BETTER LIVES AND A BETTER FUTURE**

Resilient, affordable and sustainable solutions delivering on human needs today and flourishing lives tomorrow.

## 10.1 Synergy and Acceleration Framework for Minor Research and Innovation Initiatives (SAF-MRII)

This template can be used for smaller projects and initiatives that are energy relevant but not directly linked to Ukraine's digital platform (Diia.City), or part of a flagship project. It could be hosted at a relevant agency, such as The Swedish Energy Agency or Sida, that in cooperation with relevant counterpart in Ukraine, such as a the work done by Ministry of Digital Transformation of Ukraine, Ministry of education and science of Ukraine, USAID, and UK International Development to establish WINWIN2039, would ensure that it is updated as priorities and situations change in Ukraine and Sweden.

Further details are found in supplemental Appendix R8.

## 10.2 Synergy and Acceleration Framework for STEM Research and Innovation Initiatives (SAF-STEMRII)

The AF-STEMRII framework represents a second-generation digital coordination and acceleration system for research and innovation cooperation. While the SAF-MRII framework primarily functions as a searchable and structured project-alignment database, AF-STEMRII introduces active intelligence, portfolio management and acceleration functionality.

The framework is particularly relevant for complex innovation ecosystems where multiple actors, funding streams, technologies and policy domains overlap. Areas such as:

- energy systems,
- climate transition,
- AI,
- digital infrastructure,
- resilience,
- industrial transformation,
- mobility,
- health systems,
- and municipal reconstruction

all involve highly interconnected systems where isolated projects rarely generate maximum impact on their own.

The purpose of AF-STEMRII is therefore not only to map initiatives, but also to actively support:

- strategic coordination,
- acceleration of implementation,
- portfolio optimisation,
- gap identification,
- and system-level learning.

The framework would combine:

- structured project data,

- expert evaluation,
- AI-supported analysis,
- real-time Ukrainian priority updates,
- and international research and innovation intelligence.

The system could initially be hosted by a Swedish actor such as the Swedish Energy Agency (STEM), Vinnova or a consortium involving RISE and Ukrainian counterparts, while being closely integrated with Ukrainian strategic priorities and digital governance structures.

Further details are found in supplemental Appendix R8.

## 10.3 Synergy and Acceleration Framework for Flagship Research and Innovation Initiatives (SAF-FLAGRII)

The AF-FLAGRII framework represents the most advanced and strategic level within the broader synergy and acceleration architecture. While SAF-MRII focuses on individual initiatives and AF-STEMRII focuses on portfolios and ecosystem coordination, AF-FLAGRII is designed to support flagship transformation missions with national and international significance.

The framework is intended for large-scale initiatives directly connected to:

- Ukraine's long-term innovation strategy,
- reconstruction priorities,
- post-SDG transformation agendas,
- EU integration,
- and global leadership in resilient and flourishing societies.

The platform is AI-driven, integrated into the Diia ecosystem and co-developed by Ukraine and international partners such as Sweden. Importantly, AF-FLAGRII should not be understood merely as a project-management system. It should function as:

- a transformation-governance platform,
- an international innovation infrastructure,
- and a strategic coordination mechanism for next-generation societal missions.

Further details are found in supplemental Appendix R8.

# 11. Ukraine and the Emergence of Human-Needs-Driven Innovation Ecosystems

**Summary**
Chapter 11 reframes Ukraine from a reconstruction case into a potential contributor to human-needs-driven innovation. Under war and rapid change, Ukraine has developed adaptive governance, digital services, entrepreneurship, healthcare and resilience innovations relevant to ageing societies, climate adaptation and digital transformation.

WINWIN 2030 links innovation to self-realisation, agency and opportunity. Diia and related platforms show digital governance supporting participation, services and entrepreneurship. Superhumans demonstrates systemic rehabilitation spanning health, wellbeing, employment and reintegration; its proposed city-scale expansion could prototype flourishing, accessible urban development, but is unrealised.

**Conclusions for Energy Innovation**
Energy innovation forms part of a shift from technology production to human outcomes. Success should include continuity of healthcare, water, energy, education and mobility; participation, resilience and meaningful opportunities, not only growth, patents or startup activity. Ukraine's rapid mission-oriented collaboration shows how infrastructure and essential services can adapt under disruption.

**Strategic Opportunities and Next Steps**
1. Strategic opportunity: Use WINWIN and digital governance to align innovation with capabilities, resilience and flourishing within planetary boundaries.
2. Proposed development: Explore a Superhumans-linked urban ecosystem designed around rehabilitation, accessibility, inclusion, participation and long-term wellbeing.
3. Bilateral opportunity: Use Ukrainian-Swedish city partnerships for mutual learning, combining Ukrainian resilience and digital governance with Swedish healthy-ageing, urban and energy expertise.
4. Strategic direction: Shift from generating innovations to delivery ecosystems that ensure solutions reach people and improve wellbeing, capability, trust and opportunity.
5. International opportunity: Treat Ukraine as a partner and laboratory for post-SDG, human-needs-driven innovation, not only an aid recipient.

**Chapter Structure**
Sections 11.1-11.4 cover leadership, WINWIN, Superhumans and city partnerships. Sections 11.5-11.8 examine measurement, fast innovation, delivery ecosystems and Ukraine's post-SDG potential.

## 11.1. From Reconstruction to Innovation Leadership

Ukraine is frequently framed through the lens of reconstruction, security, and recovery. While these dimensions remain critically important, such a perspective risks overlooking a broader and potentially more significant development. During the last decade, and particularly since the full-scale Russian invasion in 2022, Ukraine has emerged as one of the world's most dynamic environments for institutional innovation, digital transformation, and societal resilience. Under conditions that would normally constrain innovation capacity, the country has instead demonstrated an ability to rapidly develop new governance models, digital public services, entrepreneurial ecosystems, and healthcare innovations that increasingly attract international attention.[235,236,237,238,239,240]

This development positions Ukraine as a potentially important contributor to the next generation of innovation ecosystems. Rather than viewing innovation primarily as a mechanism for increasing productivity, competitiveness, or economic growth, a growing number of countries and organisations are exploring how innovation can contribute to broader societal objectives such as wellbeing, resilience, healthy ageing, mental health, social cohesion, and opportunities for meaningful participation in society. This shift is reflected in emerging discussions concerning post-SDG development pathways, flourishing lives, and human-needs-driven innovation systems.[241]

Within this context, Ukraine occupies a unique position. The country is simultaneously rebuilding physical infrastructure, reforming institutions, developing advanced digital governance systems, and addressing profound demographic and social challenges. As a result, Ukraine is becoming an important test environment for innovation approaches that seek to combine resilience, human wellbeing, and long-term sustainability.

The relevance of Ukraine for the Win the Future initiative therefore extends beyond reconstruction.[282] The country offers practical experience of how innovation systems can evolve under conditions of uncertainty and rapid change, providing insights that are increasingly relevant not only for post-war contexts but also for ageing societies, climate adaptation efforts, and digitally transforming economies across Europe and Asia.

235 OECD. (2024). *Enhancing resilience by boosting digital business transformation in Ukraine*. OECD Publishing. https://doi.org/10.1787/4b13b0bb-en

236 World Bank, Government of Ukraine, European Union, & United Nations. (2025). *Ukraine fourth rapid damage and needs assessment (RDNA4): February 2022–December 2024*. https://doi.org/10.1596/42908

237 OECD (2024). *Public administration in Ukraine 2023: Assessment against the principles of public administration*. https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/02/public-administration-in-ukraine_27a46a58/078d08d4-en.pdf

238 World Bank. (2024). *Digital progress and trends report 2023*. https://openknowledge.worldbank.org/bitstreams/d23c580e-617a-4c94-b844-9032f4b0250b/download

239 World Health Organization. (2025). *WHO 2025 emergency appeal: Ukraine*. https://cdn.who.int/media/docs/default-source/documents/emergencies/2025-appeals/ukraine-hea.pdf

240 United Nations Development Programme. (n.d.). EU4Recovery: Empowering communities in Ukraine. https://www.undp.org/ukraine/projects/eu4recovery-empowering-communities-ukraine-eu4recovery

241 RISE Research Institutes of Sweden. (n.d.). *Win the Future*. https://www.ri.se/sv/systeminnovation/innovationsledning/projekt/win-the-future

## 11.2. National Innovation Leadership & the WINWIN 2030 Strategy

The most visible expression of Ukraine's ambition to position itself as a future-oriented innovation nation is the WINWIN 2030 strategy developed through collaboration between the Ministry of Digital Transformation and the Ministry of Education and Science. Unlike many traditional innovation strategies, which focus primarily on technological competitiveness and economic output, WINWIN 2030 explicitly links innovation to broader societal objectives.[242]

Particularly noteworthy is the strategy's emphasis on creating conditions that enable individuals to realise their potential. One of its central objectives is the "creation of new opportunities for self-realisation of citizens". This formulation is significant because it moves beyond conventional economic indicators and implicitly recognises that innovation should be evaluated according to its capacity to expand human capabilities and opportunities. This orientation creates a natural connection with emerging international discussions around flourishing lives and human-needs-driven innovation. Similar to the capability approach developed by Sen and Nussbaum, the WINWIN framework suggests that the purpose of innovation is not merely the production of new technologies but the expansion of human freedom, agency, and opportunity.

The institutional foundations supporting this agenda are unusually strong. The Ministry of Digital Transformation has gained global recognition through the development of Diia, often described as one of the world's most advanced digital government platforms. Through Diia, citizens can access public services, manage official documents, interact with authorities, and participate in public administration through a highly integrated digital ecosystem.[243]

At the same time, complementary initiatives such as Diia.City and Diia.Business have created an environment that supports entrepreneurship, startup development, and international investment. Together, these initiatives illustrate how digital governance can function not merely as an efficiency tool but as a platform for societal transformation.
For the Win the Future initiative, Ukraine therefore offers a valuable opportunity to explore how digital governance, artificial intelligence, and innovation policy can be aligned with broader societal goals. Whereas many countries continue to treat digitalisation as a technical process, Ukraine increasingly demonstrates how digital infrastructures can be designed to support participation, resilience, entrepreneurship, and self-realisation.

**Table 11.1. Alignment between WINWIN 2030 and the Win the Future Framework**

| WINWIN 2030 Priority | Corresponding Win the Future Priority |
|---|---|
| **Self-realisation of citizens** | Flourishing lives and human capabilities |
| **Digital transformation** | AI-enabled societal resilience |
| **Innovation ecosystems** | Human-needs-driven innovation systems |
| **Entrepreneurial development** | Next-generation startup ecosystems |
| **Research and education** | Long-term societal capability building |
| **International competitiveness** | Global solution-provider leadership |

242 Ministry of Digital Transformation of Ukraine. (2024). *WINWIN: Ukraine's global innovation strategy*. https://winwin.gov.ua/assets/files/WINWIN_Main%20Presentation.pdf
243 Ministry of Digital Transformation of Ukraine. (2025). *Diia — the flagship product of Ukraine's Ministry of Digital Transformation*. https://digitalstate.gov.ua/projects/govtech/diia

## 11.3. The Superhumans Ecosystem as a Global Demonstration of Human-Needs-Driven Innovation

Among Ukraine's emerging innovation initiatives, the Superhumans ecosystem represents one of the clearest examples of a human-needs-driven innovation approach.[244] Initially established to provide prosthetics, reconstructive surgery, rehabilitation services, and psychological support to individuals affected by war, Superhumans rapidly evolved beyond its original healthcare mission.

What distinguishes the initiative is its systemic understanding of recovery. Rather than viewing rehabilitation as a narrowly defined medical intervention, the ecosystem approaches recovery as a multidimensional process involving physical capability, psychological wellbeing, social participation, education, employment, and community integration. This perspective closely resembles contemporary research on flourishing societies, healthy longevity, and capability development.

The ambition to expand the Superhumans ecosystem beyond healthcare facilities and into a broader urban development initiative is particularly significant.[245,246] If realised, the proposed city-scale development would represent one of the first attempts globally to design an urban environment explicitly around human flourishing, accessibility, rehabilitation, inclusion, and long-term wellbeing.

From the perspective of innovation systems theory, the proposed development is important because it shifts attention away from infrastructure as an end in itself and towards infrastructure as an enabler of human capabilities. Instead of asking how cities can become smarter, the initiative asks how cities can enhance people's ability to lead meaningful, healthy, and productive lives.

This distinction aligns closely with the emerging post-SDG discourse and the broader goals of Win the Future. It also creates opportunities for collaboration with Swedish and Singaporean stakeholders that have developed internationally recognised expertise in healthy ageing, urban innovation, preventive healthcare, and human-centred planning. The Superhumans initiative therefore represents considerably more than a healthcare project. It can be understood as an early prototype for a new category of human-needs-driven innovation ecosystem where healthcare, urban development, entrepreneurship, education, and digital technologies converge around the objective of improving quality of life.

244 Superhumans Center. (n.d.). *Superhumans Center: We return the super opportunities to Ukrainians*. https://superhumans.com

245 Discussion between representatives of Superhumans Center and Dennis Pamlin (personal communication, 2026).

246 President of Ukraine. (2024). *Olena Zelenska: Superhumans project for treatment and rehabilitation of wounded will be scaled up to the entire country*. https://www.president.gov.ua/en/news/proyekt-superhumans-iz-likuvannya-ta-reabilitaciyi-poranenih-91693

## 11.4. Bilateral Innovation Partnerships Between Ukraine and Sweden

The development of bilateral partnerships between Ukrainian and Swedish cities illustrates how human-needs-driven innovation can be translated into practical experimentation and implementation.

The collaboration between Kherson and Umeå is particularly noteworthy because it connects two cities facing very different but increasingly relevant societal challenges. Kherson's experience of war, reconstruction, and population displacement contrasts with Umeå's internationally recognised work on healthy ageing, social innovation, and citizen-centred urban development. Together, these perspectives create opportunities for mutual learning that extend beyond traditional development cooperation.[247]

The partnership can be understood as an opportunity to explore how urban systems can simultaneously support resilience, social cohesion, demographic adaptation, and wellbeing. Lessons emerging from Kherson's reconstruction efforts may become increasingly relevant for cities facing climate disruptions and other systemic shocks, while Umeå's experience in promoting healthy ageing and quality of life offers valuable insights for rebuilding communities around long-term human needs rather than short-term infrastructure objectives.

A similar dynamic exists in the collaboration between Vinnytsia and Helsingborg. Helsingborg has established itself as one of the leading Nordic examples of smart-city development and public-sector innovation. Vinnytsia, meanwhile, has emerged as one of Ukraine's most innovative municipalities, particularly in relation to digitalisation and public service reform.[248]

Together, these cities provide an opportunity to explore how digital technologies, energy systems, urban governance, and entrepreneurship can be integrated into broader strategies for societal wellbeing. Such collaborations are particularly important because they allow innovation to be tested in real-world settings where technological, social, economic, and environmental objectives must be addressed simultaneously.

**Table 11.2. Strategic Contribution of Ukrainian-Swedish City Partnerships**

| Partnership | Ukrainian Contribution | Swedish Contribution | Global Relevance |
|---|---|---|---|
| **Kherson-Umeå** | Resilience and reconstruction | Healthy ageing and wellbeing innovation | Climate transformation and demographic transition |
| **Vinnytsia-Helsingborg** | Digital transformation and urban governance | Smart-city systems and energy innovation | Human-centred digital urban development |

247 Umeå kommun. (2025). *Vi fortsätter visa stöd för Cherson i Ukraina*. https://www.umea.se/kommunochpolitik/nyhetsarkiv/arkivkpingang/vifortsattervisastodforchersoniukraina.5.1f75676f19a2380519844673.html

248 Helsingborgs stad. (2025). *Helsingborg stad ingår partnerskap med Vinnytsia i Ukraina*. Mynewsdesk. https://www.mynewsdesk.com/se/helsingborg/pressreleases/helsingborg-stad-ingaar-partnerskap-med-vinnytsia-i-ukraina-3414682

## 11.5. Ukraine as a Laboratory for Human-Needs-Driven Innovation

One of Ukraine's most important contributions to future innovation thinking may be its practical experience with innovation under conditions where traditional measures of progress become inadequate. In stable economies, innovation policy is often evaluated through indirect indicators such as GDP growth, productivity increases, startup formation, patent generation, employment rates, or export performance.[249,250] While these indicators remain important in certain contexts, they are fundamentally proxies rather than direct measures of whether human needs are being met.

Ukraine increasingly operates in a context where the limitations of such proxy indicators become visible. During periods of war and reconstruction, economic growth can occur simultaneously with declining quality of life, while successful delivery of essential services can occur despite severe disruptions to conventional economic activity.[251] Under such circumstances, the central policy question shifts from "How can economic output be increased?" to "How can essential human needs be met under rapidly changing conditions?" This shift has significant implications for innovation policy. Rather than evaluating success primarily through economic indicators, innovation efforts increasingly need to be assessed according to their ability to maintain healthcare services, ensure access to water and energy, support education, preserve social cohesion, enable mobility, strengthen psychological resilience, and create opportunities for meaningful participation in society.[252,253]

Ukraine's experience therefore aligns closely with emerging international discussions around human-needs-driven innovation, capability approaches, and flourishing lives. The capability approach developed by Amartya Sen and Martha Nussbaum argues that development should be evaluated according to people's real opportunities to live lives they have reason to value, rather than solely through measures of income or economic output.[254,255]

Similar arguments are increasingly appearing within sustainability and wellbeing research, where scholars argue that innovation systems should be evaluated according to their contribution to human flourishing within planetary boundaries.[256,257]

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249 OECD. (2022). *Building back a better innovation ecosystem in Ukraine*. https://doi.org/10.1787/85a624f6-en

250 World Intellectual Property Organization. (2024). *Global innovation index 2024: Unlocking the promise of social entrepreneurship* (17th ed.). https://doi.org/10.34667/tind.50062

251 World Bank, European Commission, United Nations, & Government of Ukraine. (2024). Ukraine Rapid Damage and Needs Assessment (RDNA4). https://www.worldbank.org/en/country/ukraine/publication/rapid-damage-and-needs-assessment

252 United Nations Development Programme. (2024). *Human development report 2023–24: Breaking the gridlock: Reimagining cooperation in a polarized world*. https://doi.org/10.18356/9789213588703

253 United Nations Development Programme. (2023). *Human impact assessment: Ukraine*. https://www.undp.org/ukraine/publications/human-impact-assessment

254 Sen, A. (1999). *Development as Freedom*. Oxford University Press. https://global.oup.com/academic/product/development-as-freedom-9780192893307

255 Nussbaum, M. C. (2011). *Creating capabilities: The human development approach*. Belknap Press of Harvard University Press. https://www.hup.harvard.edu/books/9780674072350

256 O'Neill, D. W., Fanning, A. L., Lamb, W. F., & Steinberger, J. K. (2018). A good life for all within planetary boundaries. *Nature Sustainability, 1*(2), 88–95. https://doi.org/10.1038/s41893-018-0021-4

257 Raworth, K. (2017). *Doughnut economics: Seven ways to think like a 21st-century economist*. Chelsea Green Publishing. https://www.chelseagreen.com/product/doughnut-economics-paperback

In practice, many Ukrainian innovation initiatives already operate according to such principles. The success of digital government platforms such as Diia is not primarily measured through technological sophistication but through their ability to ensure continuity of public services under extreme conditions, support entrepreneurship, and maintain citizen access to government functions despite war-related disruptions. Similarly, the success of rehabilitation initiatives such as Superhumans is evaluated through restored capabilities, participation, wellbeing, and quality of life rather than conventional economic indicators alone.[258]

The Ukrainian experience suggests that future innovation systems may increasingly need to distinguish between indicators that measure innovation activity and indicators that measure societal outcomes. While patents, startups, venture capital investments, and GDP remain useful indicators of innovation activity, they do not necessarily reveal whether innovation contributes to healthier, more resilient, and more flourishing societies.[259]

## 11.6. Fast Innovation Under Conditions of Disruption

Ukraine also provides important lessons regarding the speed and adaptability of innovation. Many innovation systems in advanced economies are characterised by long planning cycles, institutional complexity, fragmented responsibilities, and extensive procedural requirements. While these features can provide stability and accountability, they can also reduce responsiveness and limit experimentation.[260]

The Ukrainian innovation ecosystem has developed under very different circumstances. Faced with urgent societal challenges and rapidly changing conditions, public institutions, businesses, civil society organisations, municipalities, universities, and international partners have often been forced to collaborate in highly adaptive ways. This has resulted in unusually rapid cycles of experimentation, learning, implementation, and scaling. [261]

The rapid development of digital public services, the expansion of rehabilitation systems, the deployment of distributed energy solutions, and the emergence of new defence and resilience technologies illustrate how innovation ecosystems can function when societal needs provide a clear and shared direction. In many cases, institutional boundaries that would normally slow implementation have been replaced by mission-oriented collaboration focused on solving concrete problems.[242]

This experience is highly relevant for countries such as Sweden and Singapore. Both countries possess strong innovation systems but face increasing challenges related to ageing populations, healthcare costs, climate adaptation, infrastructure transitions, and societal

258 Superhumans Center. (n.d.). The Superhumans Team. https://superhumans.com/en/about-us/

259 Stiglitz, J. E., Sen, A., & Fitoussi, J.-P. (2009). *Report by the Commission on the Measurement of Economic Performance and Social Progress*. Commission on the Measurement of Economic Performance and Social Progress. https://ec.europa.eu/eurostat/documents/8131721/8131772/Stiglitz-Sen-Fitoussi-Commission-report.pdf

260 Mazzucato, M. (2021). *Mission economy: A moonshot guide to changing capitalism*. Allen Lane. https://marianamazzucato.com/books/mission-economy

261 European Commission. (2026). *The Ukraine Facility*. https://commission.europa.eu/topics/eu-solidarity-ukraine/eu-assistance-ukraine/ukraine-facility_en

resilience. Ukraine's experience demonstrates how mission-driven collaboration can accelerate innovation when stakeholders align around clearly defined societal outcomes rather than sector-specific objectives.

Rather than viewing Ukraine primarily as a recipient of knowledge from more established innovation systems, future collaborations should increasingly be structured as mutual learning partnerships. Sweden and Singapore can contribute expertise in governance, sustainability, urban development, healthcare innovation, and long-term planning. Ukraine can contribute expertise in rapid implementation, adaptive governance, resilience under uncertainty, digital transformation, and mission-oriented innovation.[261]

## 11.7. From Innovation Ecosystems to Delivery Ecosystems

A further lesson emerging from Ukraine concerns the distinction between innovation ecosystems and delivery ecosystems.

Traditional innovation policy often focuses on the production of innovations. Attention is directed towards research funding, startup formation, patent generation, technology transfer, venture capital attraction, and entrepreneurial activity.[262] However, the existence of innovations does not guarantee that they improve people's lives.

Ukraine's reconstruction challenge highlights the importance of delivery systems capable of translating innovations into societal outcomes. A successful innovation ecosystem is therefore not merely one that generates new solutions but one that ensures that these solutions reach people and contribute to improved wellbeing, resilience, and opportunity.[251]

This perspective resonates strongly with the Win the Future agenda and the broader ambition to create innovation ecosystems centred on flourishing lives. Future innovation leadership may increasingly depend not on who develops the largest number of innovations, but on who develops the most effective systems for delivering improvements in health, resilience, capability, trust, opportunity, and quality of life.[263]

The WINWIN 2030 strategy provides a particularly interesting example of this transition. Among its central objectives is the "creation of new opportunities for self-realisation of citizens," thereby explicitly linking innovation policy to human development rather than solely economic performance. This emphasis aligns closely with emerging international efforts to develop innovation systems capable of supporting flourishing lives while remaining compatible with global sustainability goals.

In this respect, Ukraine may become one of the most important international laboratories for exploring how innovation ecosystems can evolve into human-needs-driven delivery ecosystems. Such systems would evaluate success not only according to economic outputs but according to their contribution to flourishing lives on a flourishing planet.

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262 Frias, J., Cirera, X., Hill, J., & Li, Y. (2020). *A practitioner's guide to innovation policy: Instruments to build firm capabilities and accelerate technological catch-up in developing countries*. World Bank. https://doi.org/10.1596/33269

263 Meerow, S., Newell, J. P., & Stults, M. (2016). *Defining urban resilience: A review. Landscape and Urban Planning, 147*, 38-49. https://doi.org/10.1016/j.landurbplan.2015.11.011

## 11.8. Ukraine as a Strategic Partner in a Post-SDG Innovation Agenda

The significance of Ukraine for the Win the Future initiative ultimately extends beyond specific projects or partnerships. The country represents an emerging example of how innovation systems can evolve toward a stronger focus on human needs, resilience, and societal capability.

Many of the challenges currently shaping international policy discussions – including demographic ageing, declining mental wellbeing, climate adaptation, technological disruption, and institutional trust – cannot be addressed through technological innovation alone. They require innovation systems capable of strengthening human capabilities while operating within ecological limits.

Ukraine's experience demonstrates that crises can accelerate institutional innovation and reveal new possibilities for societal transformation. Through the WINWIN 2030 strategy, the development of advanced digital governance systems, the emergence of the Superhumans ecosystem, and growing city-to-city collaborations with Sweden, Ukraine is contributing practical examples of how innovation can be organised around human needs rather than solely around economic outputs.

For Sweden, Singapore, Switzerland and other countries participating in Win the Future, Ukraine therefore offers far more than a reconstruction case. It offers a living laboratory for the development of next-generation innovation ecosystems capable of supporting flourishing lives on a flourishing planet.

If the twentieth century was defined by industrial innovation systems and the early twenty-first century by digital innovation systems, Ukraine may help demonstrate how the coming decades can be characterised by human-needs-driven innovation systems focused on resilience, wellbeing, capability development, and long-term societal flourishing.

# Reference Appendices

# Appendix R1: Reference studies

**1) OECD: innovation system overview**
**OECD. (2023). Building back a better innovation ecosystem in Ukraine.**
https://www.oecd.org/en/publications/building-back-a-better-innovation-ecosystem-in-ukraine_85a624f6-en.html
This report explain how R&D, universities, industrial policy, business innovation, and reconstruction priorities fit together, and it is especially useful for understanding how wartime recovery could be used to build a more innovation-driven economy rather than simply restore the pre-war structure.

**2) OECD: digital transformation of firms**
**OECD. (2023). Enhancing resilience by boosting digital business transformation in Ukraine.**
https://www.oecd.org/en/publications/enhancing-resilience-by-boosting-digital-business-transformation-in-ukraine_4b13b0bb-en.html
This report focus on firm-level innovation ecosystem, particularly SMEs. It shows how digital adoption, management capabilities, and business transformation shape productivity, resilience, and the spread of innovation beyond elite startups and research institutions.

**3) OECD: macroeconomic conditions for innovation**
**OECD. (2025). OECD Economic Surveys: Ukraine 2025.**
https://www.oecd.org/en/publications/oecd-economic-surveys-ukraine-2025_940cee85-en.html
This is broader than innovation policy, but it is relevant because innovation ecosystems depend on macroeconomic stability, investment conditions, labour supply, trade capacity, and institutional credibility. It helps situate innovation policy inside the larger economic constraints and opportunities facing Ukraine.

**4) OECD: education as innovation capacity**
**OECD. (n.d.). Education GPS: Ukraine.**
https://gpseducation.oecd.org/CountryReports?primaryCountry=UKR
This source is useful for understanding the human capital base of the innovation ecosystem. It helps show how education quality, access, governance, and system performance affect the future supply of researchers, engineers, entrepreneurs, and skilled workers.

**5) European Commission: innovation performance benchmarking**
**European Commission. (2025). European Innovation Scoreboard 2025.**
https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/european-innovation-scoreboard-2025_en
This report benchmark Ukraine's innovation performance against European and global peers. It helps identify relative strengths and weaknesses across standard innovation indicators such as human resources, linkages, finance, intellectual assets, and firm innovation.

**6) European Commission: Ukraine-specific innovation profile**
**European Commission. (2025). European Innovation Scoreboard interactive tool / Ukraine profile.**

https://projects.research-and-innovation.ec.europa.eu/en/statistics/performance-indicators/european-innovation-scoreboard/eis
This is especially useful when you need the **Ukraine-specific country view** rather than just the overall EIS methodology. It helps identify which dimensions of the national innovation system underperform or outperform and supports more targeted diagnosis.

**7) European Commission: reform process and accession alignment**
**European Commission. (2025). Ukraine Report 2025 – Enlargement and Eastern Neighbourhood.**
https://enlargement.ec.europa.eu/ukraine-report-2025_en
This report is essential for understanding the **institutional reform environment** around innovation. It helps explain how rule of law, governance, public administration, education reform, business climate reform, and EU approximation affect the innovation system's long-term quality.

**8) European Commission: detailed reform documentation**
**European Commission. (2025). Ukraine Report 2025 [PDF].**
https://enlargement.ec.europa.eu/document/download/17115494-8122-4d10-8a06-2cf275eecde7_en?filename=ukraine-report-2025.pdf
The PDF version is useful because it provides the full, structured detail behind the reform assessment. It helps inform a granular reading of regulatory capacity, implementation progress, and alignment with EU standards that shape innovation, entrepreneurship, and knowledge institutions.

**9) Startup Genome: startup ecosystem under wartime conditions**
**Startup Genome. (2025). Building the Future in a War Zone: Inside Ukraine's Innovation Revolution.**
https://startupgenome.com/report/gser2025/building-the-future-in-a-war-zone-inside-ukraines-innovation-revolution
This is particularly valuable for understanding the **startup ecosystem**: founders, ecosystem resilience, venture dynamics, and how Ukraine's tech sector has adapted under extreme pressure. It is one of the clearest sources on entrepreneurial innovation specifically.

**10) Startup Genome: global comparative startup context**
**Startup Genome. (2025). The Global Startup Ecosystem Report 2025.**
https://startupgenome.com/contents/report/gser-2025_4786.pdf
This report helps place Ukraine in a wider comparative frame. It is useful when you want to understand not only what is happening inside Ukraine, but how Ukraine compares to emerging and established startup ecosystems worldwide.

**11) The Recursive: university incubators and entrepreneurial culture**
**Zaikin, A. (2026, January 15). Building a startup culture through university incubators: Ukrainian experience. The Recursive.**
https://therecursive.com/building-a-startup-culture-through-university-incubators-ukrainian-experience/
This source is especially helpful for understanding how **universities can function as incubators of entrepreneurship**, not only as teaching institutions. It gives practical insight

into how startup culture, student experimentation, and ecosystem-building can emerge from higher education.

**12) World Bank: ecosystem diagnosis**
**World Bank. (2017). Ukraine innovation and entrepreneurship ecosystem diagnostic.**
https://openknowledge.worldbank.org/handle/10986/28831?show=full
This is a foundational ecosystem diagnosis. It is valuable because it breaks the system into components affecting existing firms, startups, and international investors, helping clarify where barriers sit and which policy levers matter most.

**13) World Bank: public spending on STI**
**World Bank. (2017). Ukraine science, technology, and innovation public expenditure analysis.**
https://openknowledge.worldbank.org/handle/10986/28829
This report is particularly useful for understanding the **public-finance architecture** of innovation. It helps show how government spending on research, innovation, and entrepreneurship is structured and where public resources may be misaligned or underused.

**14) World Bank: IP and commercialisation**
**World Bank. (2017). Ukraine intellectual property and technology transfer regulatory review.**
https://openknowledge.worldbank.org/handle/10986/28830?locale-attribute=en&show=full
This is a key source for understanding how research turns into economic and social value. It helps explain the legal and regulatory obstacles to commercialisation, intellectual property management, and technology transfer from publicly funded research.

**15) World Bank: fiscal incentives for innovation**
**World Bank. (2017). Fiscal incentives for science, technology and innovation activities: Good practice review report.**
https://documents.worldbank.org/en/publication/documents-reports/documentdetail/928361509629258438
This report is most helpful for understanding the **incentive environment** for business innovation. It shows how tax and fiscal tools can encourage or discourage R&D, technology upgrading, and innovation investment.

**16) World Bank: reconstruction and productivity**
**World Bank. (2023). Engineering Ukraine's Wirtschaftswunder.**
https://openknowledge.worldbank.org/entities/publication/8a6ceaee-1491-41b1-8955-6cf41a473856
This report is useful for understanding the strategic connection between reconstruction, productivity, export competitiveness, and innovation-led growth. It helps frame innovation not as a niche sector but as part of national economic transformation.

**17) WIPO: innovation trends**
**World Intellectual Property Organization. (2025). Global Innovation Index: Ukraine: Innovation trends.**
https://www.wipo.int/gii-ranking/en/ukraine/section/innovation-trends
This source is good for understanding the **trajectory** of Ukraine's innovation capacity over time. It is helpful when you want to see whether Ukraine is improving, stagnating, or slipping on broader innovation measures.

**18) WIPO: strengths and weaknesses**
**World Intellectual Property Organization. (2025). Global Innovation Index: Ukraine: Strengths and weaknesses.**
https://www.wipo.int/gii-ranking/en/ukraine/section/strengths-weaknesses
This is useful for quickly identifying where the system is structurally stronger and weaker. It helps support more focused analysis of bottlenecks in institutions, knowledge creation, commercialisation, and business sophistication.

**19) WIPO: benchmark comparisons**
**World Intellectual Property Organization. (2025). Global Innovation Index: Ukraine: Benchmark.**
https://www.wipo.int/gii-ranking/en/ukraine/section/benchmark
This benchmark view helps compare Ukraine to similar economies or peers. It is especially useful for avoiding one-country analysis in isolation and for assessing realistic reform pathways.

**20) EBRD: transition conditions in Ukraine**
**European Bank for Reconstruction and Development. (2025). Country assessments: Ukraine [Transition Report 2025–26].**
https://www.ebrd.com/content/dam/ebrd_dxp/assets/pdfs/office-of-the-chief-economist/transition-report-archive/transition-report-2025/country-assessments/Eastern-Europe-and-Caucasus/transition-report-2025-26-CA-Ukraine.pdf
This report is valuable for understanding the broader **market and institutional transition context** in which innovation takes place. It helps explain growth constraints, investment conditions, labour issues, and structural weaknesses that shape innovation outcomes.

**21) EBRD: transition over time**
**European Bank for Reconstruction and Development. (2024). Transition Report 2024–25 Ukraine country assessment].**
https://www.ebrd.com/home/news-and-events/publications/economics/transition-reports.html
This complements the 2025–26 edition by showing how conditions are evolving over time. It helps with trend analysis around industrial policy, economic adjustment, and the enabling environment for innovation.

**22) EBRD: public procurement as innovation infrastructure**
**European Bank for Reconstruction and Development. (2025). The impact of the Prozorro procurement system on the Ukrainian economy.**
https://www.ebrd.com/content/dam/ebrd_dxp/assets/pdfs/legal-transition/Law%20in%20Transition%20journal/LiTJ%202025/ebrd-lit25-the-impact-of-the-prozorro-procurement-system-on-the-ukrainian-economy.pdf
This report is very helpful for understanding how **digital public procurement** can become part of the innovation ecosystem. It shows how transparent procurement can build trust, widen market participation, improve governance, and create better conditions for firms to compete and scale.

**23) ETF: education, training, and employment 2024**
**European Training Foundation. (2024). Key policy developments in education, training and employment – Ukraine 2024.**
https://www.etf.europa.eu/sites/default/files/2024-12/Country%20Fiche_Ukraine_2024_EN_web_0.pdf
This source helps explain the **skills ecosystem** underpinning innovation. It is especially relevant for understanding labour-market reforms, vocational education, skills alignment, and how human capital policy connects to recovery and EU accession.

**24) ETF: education, training, and employment 2023**
**European Training Foundation. (2023). Key policy developments in education, training and employment – Ukraine 2023.**
https://www.etf.europa.eu/sites/default/files/2023-11/Country%20Fiche_Ukraine_2023_EN_edited%20%281%29_0.pdf
This is useful as a near-term baseline for tracking reform momentum. It helps show how digitalisation, education modernisation, and labour-market adaptation were being framed during an earlier phase of the war.

**25) UNDP: impact investing ecosystem**
**United Nations Development Programme. (2021). The impact investing ecosystem in Ukraine.**
https://www.undp.org/sites/g/files/zskgke326/files/migration/iicpsd/The-Impact-Investing-Ecosystem-in-Ukraine.pdf
This report is especially useful for understanding the **finance side** of the innovation ecosystem. It shows where impact capital might support innovation in areas such as technology, infrastructure, renewable energy, health, education, and agriculture.

**26) UNICEF: youth skills and future readiness**
**UNICEF. (2025). Better learning and skills: Enhancing learning and creating meaningful opportunities for children and young people.**
https://www.unicef.org/ukraine/en/media/53936/file/2025_Better%20Learning%20and%20Skills%20brief.pdf.pdf
This source is useful for understanding the **future talent pipeline** of the innovation ecosystem. It highlights how skills development, inclusion, and youth opportunity shape Ukraine's long-term capacity for entrepreneurship, employment, civic participation, and recovery.

**27) UNESCO: education resilience in crisis**
**UNESCO. (n.d.). Education in emergencies: Ukraine.**
https://www.unesco.org/en/emergencies/education/ukraine
This is helpful for understanding the resilience of the education system under wartime conditions. It informs analysis of how knowledge formation, student continuity, and institutional survival affect the innovation ecosystem's long-term viability.

**28) World Bank: digitalisation of universities**
**World Bank. (2025, November 6). How digitalization, new tech are transforming Ukraine's universities.**
https://www.worldbank.org/en/news/feature/2025/11/06/how-digitalization-new-tech-are-transforming-ukraines-universities
This source is particularly useful for understanding how universities are being modernised as research and innovation institutions. It shows how digital systems, scientific equipment, and international standards can strengthen the higher-education part of the innovation ecosystem.

**29) World Economic Forum: government innovation and GovTech**
**World Economic Forum. (2025, July). Should governments act like start-ups? The case from Ukraine.**
https://www.weforum.org/stories/2025/07/ukraine-digital-transformation-government-services/
This is valuable for understanding the **GovTech dimension** of the innovation ecosystem. It shows how Ukraine's digital state, service design, and public-sector innovation can function as platforms that enable entrepreneurship, trust, efficiency, and wider technology adoption.

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Reference Appendices R2–R8 can be found in a separate document.