

EMPOWERING COMMUNITIES: NEXUS OF INFRASTRUCTURE AND LOCAL PROSPERITY

collective monograph
ed. by Olena Omelianenko and Olha Prokopenko



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The monograph explores the intricate relationship between infrastructure development and local prosperity, emphasizing how strategically implemented infrastructure projects can unlock the potential of communities. It highlights infrastructure as not merely a collection of physical assets but as a catalyst for social cohesion, economic activity, and resilience. Addressing global challenges such as economic inequality, climate change, and urbanization, the work proposes innovative approaches to sustainable community development through inclusive planning and infrastructure solutions. Featuring empirical evidence, best practices, and actionable recommendations, the monograph underscores the importance of local stakeholder engagement and environmental responsibility in achieving social equity, improving living standards, and fostering resilient economies. For scientists, teachers, doctoral and post-graduate students, students of higher education institutions, specialists and civil servants who work in the field of formation and implementation of the infrastructure policy.

Keywords: infrastructure, local prosperity, social equity, sustainable development, community participation, climate change, innovative solutions, economic activity, social cohesion, community resilience.

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INTRODUCTION

In an era characterized by unprecedented global challenges, the empowerment of communities stands as a cornerstone for sustainable development and social equity. The intricate relationship between infrastructure and local prosperity has gained increasing recognition as a fundamental driver of community empowerment, shaping not only the economic landscape but also the social and cultural fabric of societies. Infrastructure, encompassing the systems and services necessary for a community's functioning, ranging from transportation networks, energy supply and water management to communication technologies, serves as the backbone of economic activity. In parallel, local prosperity is defined by the capacity of communities to thrive economically, socially and culturally, facilitated by the active engagement of their citizens in the decision-making processes that affect their lives.

This monograph seeks to illuminate the complex nexus between infrastructure development and local prosperity, revealing how strategically implemented infrastructure projects can unlock the latent potential of communities. Historically, infrastructure has often been perceived through a narrow lens, primarily focusing on physical assets and their direct contribution to economic growth. However, a deeper exploration of this relationship unveils that infrastructure is not merely a collection of assets; it is a vital catalyst that fosters social cohesion, empowers individuals and cultivates resilience within communities. Through an examination of diverse case studies and empirical evidence, this work will demonstrate how well-planned infrastructure investments lead to tangible improvements in living standards, promote job creation and enhance social equity.

The significance of this exploration is further underscored by the myriad challenges that communities face today. Economic inequality, rapid urbanization, the impacts of climate change and the pressures of globalization necessitate innovative approaches to development that prioritize the unique needs and aspirations of local populations. Infrastructure investments, when aligned with community values and objectives, can serve as powerful enablers of change, bridging the gap between economic opportunities and social

equity. Furthermore, adopting a participatory approach to infrastructure development, where local stakeholders are actively involved in the planning and implementation processes, ensures that projects not only respond to the specific needs of communities but also foster a sense of ownership, accountability and civic pride among residents.

As we embark on a comprehensive examination of the nexus between infrastructure and local prosperity, this monograph will address several critical themes. First, we will delve into the foundational role of infrastructure in enabling economic activities. Well-designed infrastructure facilitates connectivity, enhances access to essential services and promotes the efficient movement of goods and people. For instance, reliable transportation networks can significantly reduce travel times, lower costs for businesses and enhance access to markets and services for residents, thereby contributing to overall economic vitality.

Next, we will analyze the socio-economic impacts of infrastructure investments. Infrastructure projects are often instrumental in creating jobs, not only during the construction phase but also through the subsequent operational requirements of new facilities and services. By providing training and skills development opportunities, these projects can empower local residents, enabling them to participate actively in the evolving economy. Furthermore, we will explore the role of infrastructure in promoting entrepreneurship and small business development, which are critical components of local economic ecosystems.

Additionally, this monograph will investigate how infrastructure can address social inequalities and foster inclusivity, particularly for marginalized groups. Access to quality infrastructure services, such as education, healthcare and public transportation, is crucial for improving the quality of life for all community members. By ensuring that infrastructure projects are designed with equity in mind, we can create environments that empower all residents, regardless of their socio-economic background.

Moreover, we will examine the sustainability of infrastructure projects, emphasizing the importance of environmentally responsible practices that mitigate the impacts of climate change while

promoting long-term resilience. Sustainable infrastructure development not only enhances a community's economic prospects but also safeguards natural resources, preserves ecosystems and improves the overall quality of life for residents. As communities face increasing pressures from climate-related events, such as floods, droughts and extreme weather, the need for resilient infrastructure that can withstand these challenges becomes paramount.

Throughout this monograph, we will draw on a variety of case studies that illustrate the successful integration of infrastructure and local prosperity across different contexts. By highlighting examples of best practices, innovative solutions and lessons learned, we aim to provide a comprehensive understanding of the critical linkages between infrastructure and economic vitality. These case studies will serve as valuable resources for policymakers, practitioners and community leaders seeking to implement effective strategies for community empowerment through infrastructure development.

In conclusion, monograph «Empowering Communities: Nexus of Infrastructure and Local Prosperity» aims to provide a thorough exploration of the intricate relationship between infrastructure and local economic vitality. By presenting evidence-based insights and practical recommendations, this monograph seeks to inform stakeholders about the transformative potential of strategic infrastructure investments. Ultimately, fostering local prosperity through empowered communities is not merely an aspiration; it is an essential objective for building a more equitable, sustainable and prosperous future for all. As we navigate the complexities of contemporary society, it is imperative that we recognize the profound impact of infrastructure on community empowerment and work collectively to harness its potential for positive change.

The monograph is prepared within the research project «Organizational and economic support of the post-war sustainable development of territories based on the infrastructure and service methodology of innovation communities' development» (№ 0123U100271).

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1 INFRASTRUCTURE & SERVICE PROJECTS FOR LOCAL DEVELOPMENT: PATHWAYS TO SUSTAINABLE GROWTH AND COMMUNITY EMPOWERMENT¹

1.1 General overview of infrastructure and service projects

Infrastructure and service projects play a critical role in shaping the development of societies and economies. They form the backbone of any nation's physical, economic and social framework, impacting nearly every aspect of daily life. These projects encompass a wide range of activities, from the construction of roads, bridges and water systems to the delivery of essential services like healthcare, education and public safety. The importance of these projects extends beyond mere convenience; they are pivotal in fostering economic growth, improving quality of life and ensuring the sustainability of communities.

One of the key drivers of infrastructure projects is the necessity to support economic activity. Roads, ports, railways and airports facilitate trade by enabling the efficient movement of goods and people. A robust transportation network reduces the cost of logistics, enhances productivity and fosters regional integration. For instance, in regions with poor transportation infrastructure, the cost of doing business is higher due to delays and inefficiencies in the movement of goods. Investments in transportation can significantly reduce these costs, attracting businesses and encouraging economic activity. Furthermore, such projects can create jobs during both the construction and operational phases, providing a boost to local

¹ The research is conducted within the personal scholarship of the Verkhovna Rada of Ukraine for young scientists and Ivan Vyhovsky Internship

economies and improving livelihoods.

Fig. 1.1 illustrates how access to different types of infrastructure (natural, social, engineered and institutional) varies across areas with different population densities: rural, peri-urban and urban. In rural areas, natural infrastructure (green) is abundant, while access to social, engineered and institutional infrastructures is relatively low. In peri-urban areas, access to each type of infrastructure is more balanced but still limited in engineered and institutional support. Urban areas, with the highest population density, feature minimal natural infrastructure but a substantial amount of engineered and institutional infrastructures. The green line shows a decreasing trend in natural infrastructure as population density increases.

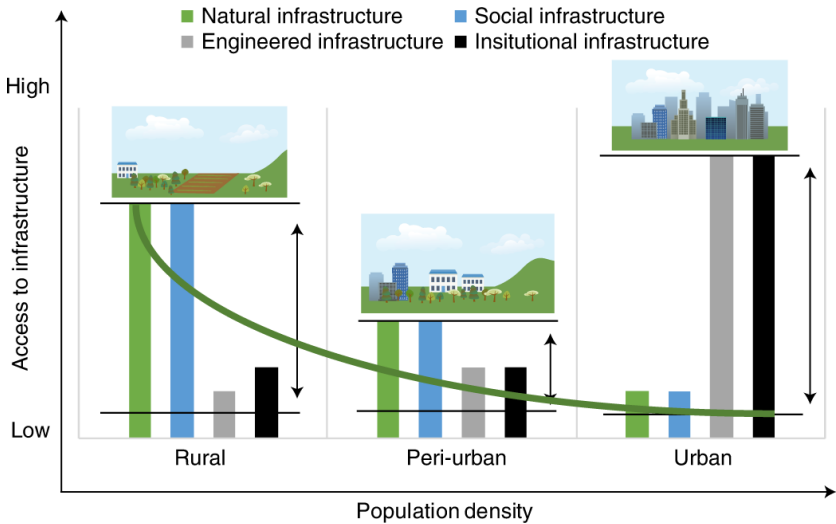


Fig. 1.1. Variation in Access to Infrastructure Across Rural, Peri-Urban and Urban Areas

Source: Mansoor Bin Jaffar, 2024

Beyond transportation, utilities like water, electricity and telecommunications are essential for economic development. Reliable access to clean water and electricity is crucial for industries, agriculture and households. Inadequate water infrastructure can lead

to scarcity, threatening food production and public health, while unreliable electricity supply can disrupt businesses and reduce the competitiveness of entire regions. Telecommunications infrastructure, particularly broadband internet, has become increasingly important in today's digital age. Access to the internet enables businesses to innovate, access global markets and participate in the knowledge economy. It also allows individuals to engage in educational and professional opportunities that were once limited to specific geographical locations.

Service projects, which are often intertwined with infrastructure development, are equally vital. These projects aim to enhance the delivery of essential public services such as healthcare, education, public safety and social welfare. In many cases, infrastructure improvements are a prerequisite for the effective delivery of these services. For instance, the construction of healthcare facilities in remote areas is necessary to provide medical care to underserved populations. Similarly, investments in educational infrastructure, such as schools and libraries, are essential for improving literacy rates and ensuring access to quality education.

Healthcare infrastructure and service delivery are particularly critical in improving public health outcomes and promoting social well-being. Investments in hospitals, clinics and sanitation systems contribute to the reduction of disease outbreaks and improve the overall health of the population. Moreover, the expansion of healthcare services into rural or underserved areas can significantly reduce health disparities and ensure that all citizens have access to essential medical care. This, in turn, leads to a healthier workforce, which is crucial for sustaining economic growth.

In the education sector, infrastructure projects such as the construction of schools and universities, as well as investments in digital learning platforms, play a vital role in human capital development. Education is widely recognized as one of the most important factors in determining the long-term economic prospects of a country. By providing individuals with the skills and knowledge needed to participate in the workforce, educational infrastructure projects help to reduce poverty, enhance social mobility and foster innovation. Furthermore, improving access to education, particularly

for marginalized or disadvantaged groups, can contribute to greater social equity and cohesion.

Public safety is another area where infrastructure and service projects intersect to create a safer and more resilient society. Investments in law enforcement infrastructure, such as police stations, fire departments and emergency response systems, are necessary to maintain public order and protect citizens from harm. In addition, the development of disaster preparedness and response infrastructure, including early warning systems, evacuation routes and shelters, is essential in mitigating the impact of natural disasters. These projects not only save lives but also protect economic assets, ensuring that communities can recover more quickly from crises.

Fig. illustrates the cascading effects of a Disruptive Event on different types of infrastructure and its broader socio-economic impact. Starting with Direct Local Impacts, the initial effects are felt most intensely by interconnected infrastructures, each influencing one another. This then leads to Indirect Impacts on Other Sectors, where sectors outside the immediate area or infrastructure type begin to experience consequences. The outermost layer represents Broader Socio-Economic Impacts, highlighting the wide-reaching effects on society and the economy. On the right, a list of Stakeholders & Decision-Makers shows various entities, from international agencies to local communities, that are affected or involved in managing these impacts, reflecting their varying levels of influence and concern.

While infrastructure and service projects are often viewed as large-scale endeavors undertaken by governments, the private sector also plays a crucial role. Public-private partnerships (PPPs) have become a common approach to financing and delivering these projects, particularly in cases where public resources are limited. Through PPPs, private companies can bring in the necessary capital and expertise to design, build and operate infrastructure and service facilities, while governments provide regulatory oversight and ensure that public interests are protected. This collaboration can lead to more efficient project implementation, higher-quality outcomes and a better allocation of resources.

However, infrastructure and service projects are not without challenges. One of the most significant obstacles is financing. Large-

scale projects require substantial financial resources, which can be difficult for both governments and private entities to secure, especially in developing or crisis-affected countries. Inadequate funding can lead to delays, cost overruns, or incomplete projects, undermining their intended benefits. Additionally, infrastructure projects often face opposition from local communities, particularly when they involve land acquisition or environmental impacts. Ensuring that these projects are environmentally sustainable and socially inclusive is critical for their long-term success.

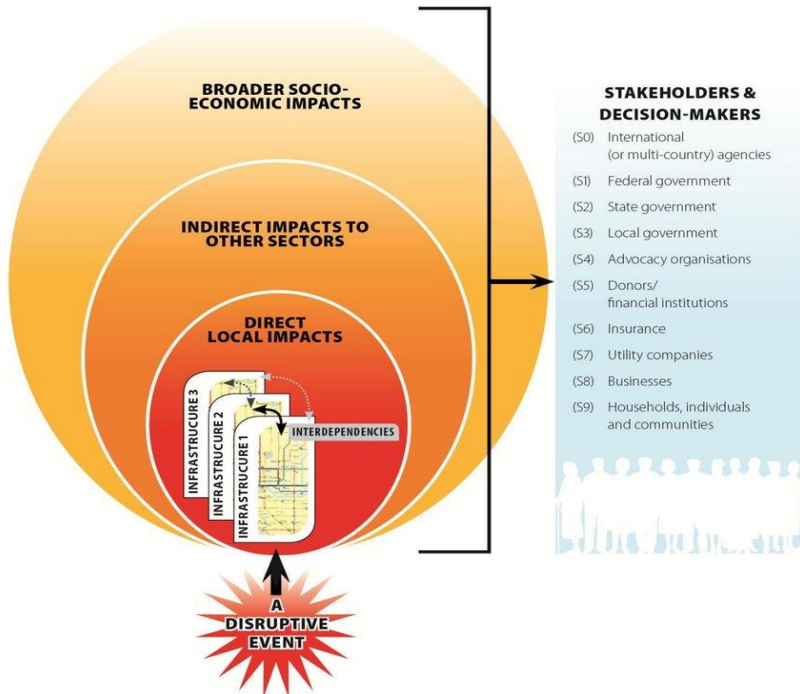


Fig. 1.2. Impact Cascade of Disruptive Events on Infrastructure and Stakeholders

Source: Hasan, S., Foliente, G, 2015.

Another challenge is the maintenance and sustainability of infrastructure once it has been built. All too often, the focus is placed on the construction phase, with insufficient attention given to the

long-term operation and maintenance of the infrastructure. Without proper maintenance, roads deteriorate, water systems break down and public facilities become unusable. It is essential for governments and private sector partners to plan for the full life cycle of infrastructure projects, ensuring that they remain functional and continue to provide benefits for future generations.

The digital transformation of infrastructure and services presents both opportunities and challenges. Smart cities, which leverage digital technologies to optimize infrastructure and service delivery, offer a glimpse into the future of urban development. These technologies can improve traffic management, energy efficiency and public safety, while also enhancing the delivery of healthcare and education services. However, the rapid pace of technological change can also create challenges in terms of digital infrastructure investments, cybersecurity and the need to ensure that all segments of society can benefit from these advancements.

The QI4SD (Quality Infrastructure for Sustainable Development) Index is intricately connected to the broader framework of the Sustainable Development Goals (SDGs), particularly through the lens of the 3Ps: People, Planet and Prosperity. This relationship emphasizes the index's comprehensive approach to assessing the quality infrastructure that supports sustainable development in social, environmental and economic dimensions.

In the context of the QI4SD Index, the «People» pillar reflects the social dimensions of sustainable development, focusing on how quality infrastructure impacts human well-being. This includes:

1. Access to basic services: evaluating the extent to which quality infrastructure enables access to essential services such as healthcare, education and clean water. This dimension highlights the importance of equitable infrastructure that meets the needs of diverse populations, especially marginalized communities.

2. Social equity and inclusion: assessing whether infrastructure initiatives promote social inclusion and reduce inequalities. This involves examining how infrastructure projects consider the needs of vulnerable groups, including women, children, the elderly and individuals with disabilities.

3. Quality of life: measuring the overall impact of infrastructure on the quality of life of individuals and communities. This encompasses health outcomes, safety and access to recreational spaces, which contribute to holistic well-being.

By focusing on the «People» pillar, the QI4SD Index ensures that social factors are integral to the assessment of quality infrastructure, recognizing that sustainable development is fundamentally about improving human lives.

The "Planet" pillar of the QI4SD Index addresses environmental sustainability, focusing on how quality infrastructure interacts with and impacts the natural environment. Key considerations include:

1. Environmental protection: evaluating infrastructure projects based on their environmental impact, including biodiversity conservation, pollution control and resource management. This involves assessing how well infrastructure initiatives align with environmental regulations and sustainability practices.

2. Climate resilience: analyzing the capacity of infrastructure to withstand climate change effects, such as extreme weather events, rising sea levels and changing environmental conditions. The index emphasizes the importance of designing resilient infrastructure that can adapt to future challenges.

3. Sustainable resource use: measuring the efficiency and sustainability of resource utilization within infrastructure projects. This includes energy consumption, water use and waste management practices, promoting a circular economy approach.

By integrating environmental considerations into the QI4SD Index, the "Planet" pillar underscores the necessity of protecting the Earth's resources and ecosystems while pursuing infrastructure development.

The «Prosperity» pillar reflects the economic dimensions of sustainable development, assessing how quality infrastructure contributes to economic growth and resilience. Important aspects include:

1. Economic growth: analyzing the role of infrastructure in fostering economic development, job creation and enhanced productivity. Quality infrastructure is critical for supporting

industries, trade and innovation, which are essential for economic prosperity.

2. Investment and financing: evaluating the availability of financial resources and investment in quality infrastructure projects. This includes assessing public and private sector investment levels, as well as the effectiveness of funding mechanisms in promoting sustainable infrastructure development.

3. Sustainable economic practices: measuring the extent to which infrastructure initiatives promote sustainable business practices and responsible consumption. This encompasses efforts to integrate social responsibility and environmental stewardship into economic activities.

Through the lens of the «Prosperity» pillar, the QI4SD Index emphasizes the importance of creating a robust economic environment that supports sustainable development while ensuring long-term growth and resilience.

The QI4SD Index serves as a vital tool for assessing the quality of infrastructure across the three pillars of sustainable development: People, Planet and Prosperity. By capturing data related to social, environmental and economic issues, the index provides a holistic view of how infrastructure systems contribute to sustainable development outcomes. Each country's score reflects its performance in these dimensions, offering insights into areas of strength and opportunities for improvement.

Ultimately, the QI4SD Index underscores the interconnectedness of social equity, environmental sustainability and economic viability, advocating for a balanced approach to infrastructure development that aligns with the objectives of the Sustainable Development Goals. By integrating these dimensions, stakeholders can make informed decisions that promote quality infrastructure as a foundation for sustainable and resilient communities.

Infrastructure and service projects possess a number of distinct features that distinguish them from other types of development initiatives. These characteristics shape the planning, execution and impact of such projects, making them crucial for economic growth, societal well-being and sustainable development. Below are the key

features that define infrastructure and service projects:

1. Large scale and long-term focus. Infrastructure projects, such as roads, bridges, water systems and public buildings, typically involve large-scale construction efforts that require substantial financial investment and time. These projects are designed to serve large populations and geographic areas, often spanning multiple decades in terms of their lifespan. The scale of these projects also reflects their importance in shaping the foundational systems that support societal functions, such as transportation, communication and public utilities.

Similarly, service projects like healthcare, education, or public safety initiatives also operate with a long-term focus, aimed at delivering sustained benefits to communities. The infrastructure supporting these services often needs to be robust and designed for long-term use, requiring planning that goes beyond immediate needs to address future demand and technological advancements.

2. Capital intensive. Both infrastructure and service projects are highly capital-intensive, requiring significant financial resources for planning, construction and operation. Governments often allocate large portions of their budgets to infrastructure development and private investors may also be involved, especially in public-private partnerships (PPPs). This capital intensity covers not only the construction phase but also the long-term maintenance and operational costs of the infrastructure or services being provided.

The high cost of such projects means that they often require financing from multiple sources, including national budgets, international loans and private investment. This also places an emphasis on cost-benefit analysis and financial sustainability during the planning stages.

3. Public utility and social value. Infrastructure and service projects provide essential public utilities and services that form the foundation of societal well-being. They include roads, bridges, water supply systems, sanitation facilities, energy grids and telecommunications networks – each of which is critical for the functioning of modern societies. Service projects, such as education and healthcare, address fundamental human needs, directly impacting quality of life, equity and social mobility.

This social value makes infrastructure projects politically and socially sensitive. The distribution of infrastructure services often reflects broader policy objectives, such as reducing regional inequalities or improving the quality of life in underdeveloped areas. Because of this, governments may prioritize certain infrastructure projects to align with national or regional development goals.

4. Complexity and multi-sector involvement. Infrastructure and service projects often involve a wide range of sectors and stakeholders, from government agencies and regulatory bodies to private contractors, financiers and local communities. This complexity means that project coordination and management are critical. Engineers, urban planners, economists, environmentalists and policymakers all play roles in ensuring that projects are feasible, sustainable and align with broader development objectives.

Infrastructure projects, especially those involving transportation, energy, or water systems, often require intricate coordination between different levels of government, private investors and sometimes international organizations. This multi-sector involvement increases the complexity of project management, as aligning the goals and interests of all stakeholders is a key challenge.

5. Environmental and social impact. A defining feature of infrastructure projects is their potential environmental and social impact. Major construction projects can significantly alter landscapes, ecosystems and local communities. Environmental considerations, such as minimizing habitat destruction, controlling pollution and ensuring sustainable resource use, must be integrated into the planning stages. Many countries now require environmental impact assessments (EIAs) before approving large-scale projects to ensure that these considerations are addressed.

In addition to environmental impacts, infrastructure and service projects often have significant social consequences. The construction of new roads, dams, or urban developments can result in displacement of communities, changes to local economies and shifts in land use patterns. Projects must consider these potential disruptions and ensure that they are addressed through inclusive planning, compensation schemes, or community engagement

initiatives.

6. Regulatory and compliance requirements. Infrastructure and service projects are heavily regulated due to their large-scale and public importance. They must adhere to a variety of local, national and sometimes international regulations, including building codes, environmental laws, safety standards and labor regulations. The complexity of navigating these regulatory frameworks can be a significant challenge, often requiring extensive legal and bureaucratic processes to ensure compliance.

Moreover, service projects, such as healthcare or education initiatives, are often subject to stringent standards regarding the quality of services provided, the qualifications of personnel and accessibility. These regulatory requirements are designed to protect public interests and ensure that the infrastructure or services delivered are safe, reliable and equitable.

7. Resilience and sustainability. Modern infrastructure and service projects increasingly emphasize resilience and sustainability, particularly in the face of climate change, natural disasters and resource scarcity. Resilient infrastructure is designed to withstand shocks like floods, earthquakes and other emergencies, ensuring that communities can continue to function even during crises.

Sustainability, on the other hand, refers to the long-term environmental, social and economic viability of infrastructure projects. Sustainable infrastructure integrates renewable energy sources, minimizes resource waste and reduces carbon footprints. It also considers the long-term impact on local communities and ensures that infrastructure development contributes to broader goals of sustainability, such as reducing inequality and fostering inclusive growth.

8. Technological integration. Advancements in technology are transforming both the construction and operation of infrastructure and service projects. Smart technologies, such as sensors, automation and data analytics, are increasingly being integrated into infrastructure systems to improve efficiency, reduce costs and enhance service delivery. For example, smart grids in the energy sector allow for more efficient distribution of electricity, while smart transportation systems can reduce traffic congestion and improve

safety. In the service sector, digital technology plays a key role in enhancing healthcare delivery through telemedicine, improving education through e-learning platforms and streamlining public services through online government portals. Technological integration not only improves the performance of infrastructure and services but also helps to future-proof these systems against rapidly evolving technological landscapes.

9. Economic multiplier effect. Infrastructure and service projects have a powerful economic multiplier effect, meaning they generate broader economic benefits beyond their immediate function. For example, the construction of new roads not only provides transportation access but also stimulates local businesses, reduces travel time, lowers logistics costs and increases productivity. Similarly, investments in healthcare infrastructure can lead to a healthier workforce, which in turn enhances economic productivity.

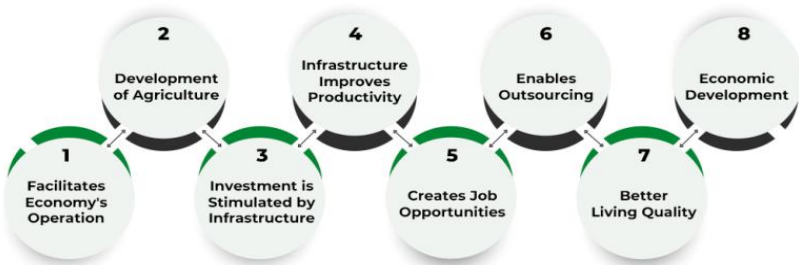


Fig. 1.1. Economic impacts of infrastructure and service projects

These economic benefits often extend into the long term, as infrastructure projects create lasting value by improving a region's attractiveness for investment, reducing transaction costs and enhancing human capital development. This multiplier effect makes infrastructure and service projects a key focus for governments seeking to drive economic growth and development.

1.2 Impacts of infrastructure and service projects

When evaluating the impacts of infrastructure and service projects, it's important to consider a broad range of both positive and negative effects across multiple dimensions. These impacts extend beyond the immediate economic and physical changes, often affecting social, environmental and cultural aspects of a community. Here's a comprehensive look at the different types of impacts that can be considered:

1. Economic impacts. Infrastructure and service projects are often viewed through an economic lens, as they can significantly influence the local and regional economy. Some key economic impacts include:

- job creation: both during construction and post-completion, infrastructure projects generate employment opportunities. These include short-term construction jobs as well as long-term roles in operations, maintenance and service delivery;

- economic growth: infrastructure projects can stimulate local economic activity by improving transportation, energy supply, or communication networks, making it easier for businesses to operate and for goods and services to flow efficiently;

- increased property values: new or improved infrastructure (such as roads, public transportation, or utilities) often leads to higher property values in the surrounding areas due to improved accessibility and amenities;

- attraction of investment: well-executed projects can attract external investment, boosting local businesses, creating further job opportunities and fostering innovation;

- cost savings: upgraded infrastructure, such as energy-efficient systems or better transportation networks, can lead to reduced operating costs for businesses and households.

2. Social impacts. The social dimension of infrastructure and service projects is closely tied to how the community experiences changes brought about by these initiatives. Key social impacts include:

- improved quality of life: access to better services such as healthcare, education, clean water and electricity leads to an overall

improvement in living standards;

- social inclusion: projects that focus on public services often aim to reduce inequalities by providing underserved or marginalized populations (such as the elderly, disabled, or low-income groups) with improved access to essential services;

- cultural preservation or disruption: infrastructure projects may impact cultural sites or practices. For example, building a new highway might cut through an area of cultural significance, whereas projects focused on restoring heritage sites could have a positive impact;

- displacement of residents: infrastructure projects, especially large ones like dams, highways, or urban redevelopment, can lead to the physical displacement of communities, causing significant social disruptions;

- health impacts: projects that improve healthcare infrastructure can reduce mortality rates, improve public health outcomes and increase life expectancy. Conversely, some projects (e.g., industrial or energy plants) may negatively impact public health due to pollution or hazardous working conditions;

- community engagement and empowerment: properly managed projects that involve local communities in decision-making processes can strengthen social cohesion, build trust and empower residents to participate in shaping their environment.

3. Environmental impacts. The environmental consequences of infrastructure and service projects can be significant and both positive and negative impacts must be considered. Some common environmental impacts include:

- environmental degradation: infrastructure projects can lead to deforestation, habitat destruction, air and water pollution and loss of biodiversity, especially in the case of large construction projects like highways, airports, or energy plants;

- carbon footprint and climate change: large infrastructure projects that rely on heavy machinery, concrete production and energy consumption often contribute to greenhouse gas emissions. However, projects that focus on renewable energy or green technologies can help reduce carbon footprints;

- resource depletion: projects such as dams, energy plants, or

mining operations may lead to the overuse of natural resources like water, minerals, or fossil fuels;

- positive environmental contributions: certain infrastructure projects, especially those focused on environmental restoration, water management, or renewable energy, can have positive environmental impacts, such as reducing pollution, improving water quality, or restoring ecosystems;

- sustainability: projects that are designed with sustainable principles, such as green building practices or the incorporation of renewable energy sources, can contribute to long-term environmental resilience.

4. Political and governance impacts. Infrastructure projects often have political implications, especially when they involve public spending, land acquisition, or are central to government development policies. Political and governance impacts include:

- public trust and governance: projects that are transparent, efficiently managed and successfully completed can increase public trust in government institutions. On the other hand, mismanagement, corruption, or delays can erode confidence;

- policy influence: large infrastructure projects can shape future policy direction by highlighting the need for regulatory changes, new investment frameworks, or the adoption of sustainability practices in public policy;

- geopolitical relations: large cross-border infrastructure projects, such as pipelines, railways, or roads, can influence geopolitical relationships by fostering regional cooperation or competition;

- local political power: in many cases, infrastructure projects can enhance the power and influence of local political leaders who are seen as champions of development, or they may become politically controversial due to opposition from communities or interest groups.

5. Technological impacts. The advancement and integration of new technologies in infrastructure and service projects can lead to several long-term impacts on how communities operate:

- innovation and technological adoption: infrastructure projects that incorporate new technologies (e.g., smart city solutions,

renewable energy grids, or digital communication networks) can help communities become more innovative and technologically advanced;

- skills development: projects that introduce advanced technologies often require new skills and expertise, creating demand for workforce training and development. This enhances local human capital and helps communities stay competitive;

- improved efficiency: new technology in transportation, energy and communication infrastructure can make systems more efficient, reducing waste and improving service delivery.

6. Cultural and heritage impacts. Cultural heritage and community identity can be both positively and negatively affected by infrastructure and service projects:

- preservation of cultural sites: projects that include elements of cultural preservation, such as restoring historical buildings or protecting natural landmarks, contribute to safeguarding cultural heritage for future generations;

- disruption of traditions: large projects may displace or disrupt cultural practices and traditions, particularly if they involve construction in or near sites of cultural or religious significance;

- cultural exchange: projects that promote tourism, such as improving access to natural and cultural sites, can foster cultural exchange and bring economic benefits to local communities, but they may also lead to the commercialization or loss of traditional practices.

7. Long-term sustainability and resilience impacts. One of the most crucial considerations in evaluating the impact of infrastructure and service projects is their long-term sustainability and resilience:

- resilience to natural disasters: infrastructure designed with climate resilience in mind (e.g., flood defenses, earthquake-resistant buildings) helps communities mitigate the impacts of natural disasters and recover more quickly;

- economic and environmental sustainability: projects that consider sustainability principles, such as using renewable energy, minimizing waste, or building with sustainable materials, contribute to long-term environmental and economic stability;

- dependency and self-sufficiency: some projects, particularly those involving external financing or expertise, can create a

dependency on external entities. In contrast, projects that focus on building local capacity and self-sufficiency ensure that the community can maintain and expand the infrastructure in the future.

So infrastructure and service projects are essential for economic development, social well-being and environmental sustainability. They enable the efficient functioning of economies, improve the quality of life for citizens and ensure that communities can withstand and recover from crises. However, these projects must be carefully planned, financed and maintained to ensure that their benefits are realized over the long term. Collaboration between governments, the private sector and local communities is critical to overcoming the challenges associated with infrastructure development and ensuring that these projects contribute to a more equitable, prosperous and sustainable future.

Infrastructure and service projects can be considered as foundational to the advancement of economies and societies, characterized by their large scale, capital intensity, complexity and significant social and environmental impact. Their development requires careful planning, sustained investment and alignment with regulatory, technological and sustainability considerations to ensure they meet the needs of current and future generations.

The impacts of infrastructure and service projects are multifaceted and interconnected, influencing economic, social, environmental, political, technological and cultural spheres. Evaluating these impacts comprehensively is essential for understanding the full scope of how a project affects a community in both the short and long term. While infrastructure projects are often undertaken to achieve positive development outcomes, they must be designed and implemented carefully to mitigate potential negative consequences, ensure sustainability and maximize their benefits to the local population.

1.3 Local infrastructure and service projects in communities

Local infrastructure and service projects are essential to the well-being and development of communities, directly impacting the everyday lives of residents. These projects range from small-scale initiatives, such as upgrading local roads or improving public services, to more ambitious endeavors, such as building healthcare facilities or expanding digital infrastructure. Unlike national or regional projects, local infrastructure projects focus on the specific needs of a particular community and they often reflect the unique economic, social and environmental characteristics of the area. Here's a deeper look at how local infrastructure and service projects function within communities and their broader implications.

Transformative infrastructure development refers to the strategic planning and implementation of infrastructure projects that have a long-lasting positive impact on remote regions. By overcoming the existing limitations and barriers, transformative infrastructure development has the potential to (Mansoor Bin Jaffar, 2024):

1. Enhance connectivity and accessibility, enabling remote communities to connect with the outside world and access vital services;
2. Drive economic growth and development by attracting investments, creating job opportunities and stimulating local businesses;
3. Improve quality of life for residents by providing access to essential services such as healthcare, education and clean water;
4. Foster sustainable development by incorporating renewable energy sources, efficient transportation systems and green infrastructure.

A number of regions face a myriad of challenges that hinder their progress and development. Transformative infrastructure development tackles these challenges head-on, offering effective solutions to (Mansoor Bin Jaffar, 2024):

1. Geographic Barriers: regions often have rugged terrains, making infrastructure development a complex task. Innovative approaches such as aerial surveys, autonomous drones and precision

engineering can overcome these barriers and enable the creation of suitable infrastructure.

2. Lack of connectivity: limited access to modern communication networks isolates remote regions from the digital world, hindering growth and diminishing opportunities. By integrating high-speed internet connectivity and telecommunication networks, transformative infrastructure development bridges the connectivity gap.

3. Resource constraints: regions may have limited access to resources required for infrastructure development, such as construction materials and energy sources. By developing sustainable solutions that harness local resources and incorporate renewable energy, transformative infrastructure development ensures long-term resource availability.

4. Socio-economic disparities: regions often suffer from inadequate healthcare facilities, education systems and job opportunities. Transformative infrastructure development prioritizes the establishment of essential services, empowering local communities and leveling the playing field for economic and social progress.

Successful implementation of transformative infrastructure development relies on several critical factors:

1. Collaboration and partnerships: effective collaboration between governments, private entities and local communities is essential for identifying needs, securing funding and implementing infrastructure projects.

2. Sustainable design: emphasizing sustainable and resilient design principles ensures infrastructure projects can withstand environmental challenges and minimize their ecological impact.

3. Innovation and technology: harnessing innovative technologies such as Internet of Things (IoT), Artificial Intelligence (AI) and renewable energy solutions enhance the efficiency and effectiveness of infrastructure development in remote regions.

4. Capacity building: investing in local skills development and training programs enables remote communities to actively participate in infrastructure development, promoting sustainability and self-reliance.

E.g. local transportation infrastructure is crucial for ensuring that people can easily move within and between communities. This includes the construction and maintenance of local roads, sidewalks, bike lanes and public transportation systems such as buses and light rail. In rural areas, upgrading local roads might mean improved access to larger urban centers, enabling residents to connect with employment opportunities, healthcare and education. In urban areas, transportation projects often focus on reducing traffic congestion, improving safety and creating pedestrian-friendly spaces.

For instance, a small town might invest in paving previously unpaved roads, thereby improving access to local markets and making transportation easier during harsh weather. In larger towns or cities, constructing or improving public transportation systems could reduce dependence on cars, lower emissions and make commuting more affordable for residents.

Access to clean water and proper sanitation is a fundamental need for any community. Local infrastructure projects focused on water systems ensure that residents have access to clean drinking water, efficient waste removal and wastewater treatment. In many rural areas, these projects may involve the construction of boreholes, wells, or water filtration plants to provide a sustainable water supply. In urban settings, water infrastructure projects might involve expanding the capacity of existing sewage systems or upgrading aging water pipelines to prevent contamination.

For communities that face issues with flooding, local governments may prioritize projects that improve drainage systems or build flood prevention infrastructure, such as levees or retention ponds. These investments not only protect the local population but also preserve property values and safeguard public health.

Ensuring reliable access to energy is vital for both residential and commercial activities within a community. Local energy infrastructure projects may involve the expansion of electricity grids to previously underserved areas, the installation of solar panels in public buildings, or even the development of small-scale wind farms to provide renewable energy. In off-grid rural areas, electrification projects using renewable energy sources can provide power for homes, schools and healthcare facilities, dramatically improving the

quality of life.

Upgrading energy infrastructure within a community often includes modernizing outdated grids, installing smart meters and introducing energy efficiency programs. By investing in such projects, local governments can reduce energy costs for residents, decrease dependency on fossil fuels and create more resilient energy systems capable of withstanding extreme weather events.

Local healthcare infrastructure projects have a direct and immediate impact on public health. Communities benefit immensely from the construction of hospitals, clinics and specialized healthcare centers, particularly in areas where access to medical services is limited. Local governments might also invest in mobile health units or telemedicine platforms to ensure that residents in remote or underserved areas receive the care they need.

In addition to physical infrastructure, healthcare service projects may involve training healthcare workers, equipping hospitals with modern technology and improving the supply chains for medical supplies. These improvements help reduce healthcare disparities, improve patient outcomes and provide timely care to populations that might otherwise be left behind.

Education is a cornerstone of community development and local infrastructure projects focused on schools and learning centers are vital to improving literacy, skill development and long-term economic growth. In rural or underserved communities, the construction of new schools, libraries and vocational training centers can make a transformative difference. In urban areas, infrastructure projects might focus on upgrading existing schools, improving access to digital learning technologies and expanding facilities to accommodate growing student populations.

Educational service projects may include teacher training, school meal programs and extracurricular activities that enhance the learning experience. Local initiatives like these help bridge educational gaps and ensure that all children have access to quality education regardless of their socio-economic background.

Public safety is a critical concern for any community and local infrastructure projects in this area can range from building or renovating police stations, fire stations and emergency response

centers to installing street lighting and surveillance systems to reduce crime. Improving local law enforcement and emergency response infrastructure ensures that communities are better prepared to handle both everyday safety concerns and more severe incidents like natural disasters.

Additionally, emergency service infrastructure, such as evacuation routes, storm shelters and early warning systems, can be vital in areas prone to floods, hurricanes, or earthquakes. These projects not only protect lives but also provide peace of mind to residents, knowing that their community is equipped to handle emergencies.

Creating and maintaining public spaces, such as parks, sports facilities and community centers, contributes significantly to the social cohesion and well-being of a community. These local infrastructure projects provide places for recreation, cultural events and social gatherings, promoting a sense of community identity and encouraging healthier lifestyles.

In urban areas, the development of green spaces can improve air quality, reduce heat island effects and provide residents with opportunities for exercise and relaxation. In rural areas, public spaces can become focal points for community events, fostering greater interaction and cooperation among residents.

As the world becomes increasingly interconnected, digital infrastructure is becoming a key element of local development. Projects that focus on expanding broadband internet access, particularly in rural or underserved areas, help bridge the digital divide, providing residents with access to information, education and economic opportunities. In small towns and rural regions, internet connectivity can allow businesses to reach new markets, students to participate in online learning and healthcare providers to offer telemedicine services.

Urban areas might focus on developing smart city technologies, where digital infrastructure supports more efficient management of resources like energy, water and transportation. For example, smart traffic management systems can reduce congestion, while sensors can monitor water usage to prevent waste.

Effective waste management is a critical local infrastructure

issue, impacting public health, environmental sustainability and overall quality of life. Local waste management projects may involve the construction of recycling centers, landfills, or waste-to-energy plants. Communities might also invest in upgrading their waste collection and disposal systems, improving the frequency and reliability of trash removal services.

In areas where illegal dumping is a problem, local governments might focus on public education campaigns, stronger enforcement of environmental laws, or the development of more accessible waste disposal options to reduce pollution and protect natural resources.

Many local infrastructure and service projects are designed with economic development in mind. For example, upgrading roads and utilities in a specific area may encourage businesses to open new shops, factories, or offices. Local governments may also invest in tourism infrastructure, such as visitor centers, historical landmarks and cultural festivals, to attract tourists and stimulate the local economy.

Similarly, service projects that provide vocational training or small business support can empower local residents, helping them start businesses, improve their skills and contribute to the community's economic growth. These projects are particularly important in post-crisis or post-war recovery contexts, where rebuilding the local economy is essential for long-term stability and prosperity.

Local infrastructure and service projects are essential to the fabric of community life, providing the physical and social foundations for a thriving society. From transportation and healthcare to digital connectivity and public safety, these projects address the unique needs of each community, contributing to improved quality of life, economic opportunity and environmental sustainability. By focusing on local needs and engaging community members in the planning and implementation of these projects, governments can ensure that infrastructure investments deliver tangible and lasting benefits for residents.

1.4 Infrastructure and service projects management

Managing infrastructure and service projects is a complex and multifaceted process that involves careful planning, coordination and execution to ensure that projects meet their goals, stay within budget and are completed on time. These projects, which can range from building roads and bridges to improving public services like healthcare and education, require collaboration among various stakeholders, including government agencies, private contractors, financiers and local communities. Effective management is critical to ensuring that infrastructure and service projects not only deliver their intended benefits but also contribute to long-term economic and social development.

Fig. 1.2 illustrates the Infrastructure project lifecycle, which consists of six sequential phases essential for managing infrastructure projects. Beginning with planning, it involves defining the scope, conducting feasibility studies and designing the project.

The following sections detail key aspects of managing these projects.

1. Project planning and feasibility analysis. The first stage of infrastructure and service project management is comprehensive planning and feasibility analysis. This involves identifying the specific needs of the community, understanding the scope of the project and conducting studies to ensure its viability. Feasibility studies typically assess the technical, financial, environmental and social aspects of the project to determine whether it is practical and sustainable.

The planning phase includes setting clear project objectives, such as improving transportation, expanding access to healthcare, or enhancing digital infrastructure. A detailed project plan outlines the expected outcomes, the resources required, the timeline and the budget. This phase also involves risk assessment, identifying potential challenges and developing mitigation strategies to address them.



Fig. 1.2. Infrastructure project lifecycle

Source: Eby, 2024

2. Budgeting and financing. Infrastructure and service projects are often capital-intensive, requiring substantial financial resources. One of the critical tasks in managing these projects is securing financing, which can come from a variety of sources, including government budgets, international loans, private investment, or public-private partnerships (PPPs). The management team must ensure that the project is financially sustainable and that funds are allocated efficiently.

Creating a detailed budget is essential in this phase, as it defines the cost structure of the project, including construction, labor, materials, equipment and ongoing operational expenses. Cost overruns are a common challenge in infrastructure projects, so

project managers must continuously monitor expenditures and ensure that costs stay within the allocated budget. Financial management also involves securing contingencies for unforeseen expenses and ensuring transparency in financial reporting.

3. Stakeholder management. Infrastructure and service projects typically involve multiple stakeholders, each with their own interests and priorities. These include government agencies, private sector contractors, financial institutions, regulatory bodies and the local community. Effective stakeholder management is crucial to aligning these diverse interests and ensuring smooth collaboration throughout the project's lifecycle.

Stakeholder engagement begins during the planning phase, where project managers must consult with key parties to ensure their needs and concerns are considered. For example, community consultations are vital to understanding the potential social impacts of a project and mitigating any negative consequences, such as displacement or environmental degradation. Regular communication with stakeholders helps build trust, ensure accountability and resolve conflicts that may arise during the project.

4. Regulatory compliance and permitting. Infrastructure and service projects are subject to a wide range of regulatory requirements, including environmental laws, construction codes, safety standards and labor regulations. Project managers must ensure that all necessary permits are obtained before the project begins and that the project adheres to all applicable regulations throughout its duration.

Failure to comply with regulatory requirements can lead to delays, fines and even the cancellation of the project. As such, it is essential for project managers to work closely with legal experts, regulatory agencies and environmental assessors to ensure that the project is fully compliant with local, national and sometimes international regulations.

5. Procurement and contract management. A significant part of managing infrastructure projects involves procuring goods and services needed for construction, operation and maintenance. This includes contracting construction companies, acquiring materials and hiring specialized services, such as architects, engineers, or

environmental consultants. Effective procurement processes ensure that the project gets the best value for money while meeting quality and timeline requirements.

Project managers must oversee the drafting of contracts that clearly outline the roles and responsibilities of contractors, subcontractors and service providers. Contract management involves monitoring contractor performance, ensuring that work is completed according to the specifications and resolving any disputes that arise during the course of the project.

6. Risk management. Infrastructure and service projects are often subject to a range of risks, including financial, environmental, technical and political challenges. Managing these risks is a critical component of project management. A risk management plan should be developed early in the project lifecycle, identifying potential risks and outlining strategies to mitigate or respond to them.

Common risks include delays due to regulatory approvals, cost overruns, unexpected environmental impacts, labor shortages, or political instability. Effective risk management requires regular monitoring and adjustment of the project plan as conditions change. Contingency planning ensures that the project can continue moving forward even when unforeseen events occur.

7. Project execution and monitoring. Once the project enters the execution phase, it is essential to monitor progress closely to ensure that all activities are aligned with the project plan. Project managers are responsible for coordinating the day-to-day operations, including managing contractors, scheduling tasks and ensuring that construction or service implementation stays on track.

Progress tracking involves setting clear milestones and using project management software to monitor the status of various tasks, track resources and report on key performance indicators (KPIs). These KPIs may include the percentage of tasks completed, budget adherence and the quality of work. Regular status meetings with the project team and stakeholders ensure that everyone is informed about the project's progress and any potential issues.

8. Quality control and assurance. Maintaining high-quality standards throughout the project is essential to ensuring the success and sustainability of infrastructure and service projects. Quality

control involves regular inspections of construction work, materials and equipment to ensure they meet the specified standards and regulations. For service projects, quality assurance may include evaluating the effectiveness of service delivery, such as healthcare or educational programs, ensuring they meet community needs and expectations. Project managers may employ third-party inspectors or quality assurance teams to conduct audits and assess whether the project is meeting the necessary technical and safety requirements. These assessments ensure that any defects or deficiencies are identified and corrected before the project is completed.

9. Environmental and social impact management. Many infrastructure projects have significant environmental and social impacts, particularly when they involve large-scale construction or development in sensitive areas. Managing these impacts is critical for the long-term sustainability of the project and the well-being of the community. Project managers must ensure that the project adheres to environmental protection laws and implements strategies to minimize negative impacts, such as pollution, deforestation, or habitat destruction.

In addition, social impact assessments help project managers understand how the project will affect local communities. For example, projects that involve land acquisition or displacement of residents must include compensation plans, community engagement and strategies to mitigate any disruptions to livelihoods.

Management of infrastructure and service projects requires a multidisciplinary approach that integrates technical expertise, financial management, stakeholder engagement and regulatory compliance. By focusing on careful planning, risk management and quality control, project managers can ensure that infrastructure and service projects are completed successfully, delivering long-term benefits to communities and contributing to broader economic and social development. The complexity and scale of these projects demand strong leadership, effective communication and adaptability to navigate challenges and maximize the impact of these vital investments.

1.5 Local human capital as a source and objective of infrastructure & service projects

Local human capital plays a dual role in infrastructure and service projects, it serves both as a key resource driving the execution of these projects and as a primary beneficiary or objective of their outcomes. In the context of community development, the people within a region are essential for the successful planning, implementation and sustainability of projects. At the same time, the improvement of local human capital through education, skills development and employment opportunities is a fundamental objective of many infrastructure and service initiatives. Here's a deeper exploration of how local human capital functions as both a source and an objective in such projects.

To characterize human capital as a source for infrastructure and service projects forms we can highlight such main points:

1. **Skilled workforce for project implementation.** One of the most critical ways that local human capital supports infrastructure and service projects is through the availability of a skilled workforce. Local engineers, construction workers, planners and service providers (such as healthcare professionals, educators and technicians) are integral to the execution of these projects. Communities that possess a pool of trained and skilled workers can implement projects more efficiently and with a greater sense of ownership. Furthermore, employing local talent reduces costs related to importing labor and encourages knowledge transfer within the community.

For instance, when a community undertakes the construction of new transportation infrastructure, such as roads or bridges, it relies heavily on local architects, civil engineers and construction laborers to bring the project to fruition. Similarly, service projects aimed at improving healthcare or education systems depend on local doctors, teachers and administrators to run and sustain these services.

2. **Engagement in project planning and decision-making.** Local human capital is not only about technical skills; it also encompasses the knowledge, experience and leadership within the community. Involving local residents, business leaders and community

organizations in the planning and decision-making processes of infrastructure and service projects is crucial. This engagement ensures that the projects are responsive to the actual needs of the community and that the design and implementation strategies align with local conditions, cultural practices and preferences.

For example, a project to improve waste management infrastructure may greatly benefit from the input of local environmental experts, community leaders and residents who understand the area's specific challenges with waste disposal and recycling. Their participation increases the likelihood that the project will be both effective and sustainable.

3. Local entrepreneurship and innovation. Local human capital also contributes to infrastructure and service projects through entrepreneurship and innovation. In many communities, local businesses and startups play an important role in developing innovative solutions to infrastructure problems. Entrepreneurs might offer new technologies or approaches for renewable energy, smart transportation systems, or digital service delivery, contributing to the efficiency and effectiveness of the project.

Moreover, local small and medium-sized enterprises (SMEs) often participate in infrastructure projects as contractors or service providers, thus reinforcing the local economy and creating a positive feedback loop that fosters community development. In cases where large infrastructure projects, like public transportation or broadband internet expansion, are undertaken, local businesses might find new opportunities to grow by leveraging these improved services.

From the main characteristics of human capital as an objective of infrastructure and service projects we can highlight:

1. Education and skills development. Many infrastructure and service projects directly aim to enhance local human capital through educational and vocational training programs. For instance, the construction of schools, vocational training centers, or adult education programs serves the dual purpose of providing physical infrastructure while improving the educational attainment and skills of the local population. These projects are designed to equip individuals with the knowledge and competencies they need to participate more fully in the local economy and contribute to future

infrastructure development.

Projects related to digital infrastructure, such as expanding internet access, not only provide communities with the physical tools needed to connect to the global economy but also offer opportunities for digital literacy training. This enhances the ability of residents to participate in the digital economy, improving their employment prospects and overall quality of life.

2. Job creation and economic. Empowerment infrastructure and service projects are often major drivers of employment, both during the construction phase and after the project is completed. For example, building a hospital or school generates short-term construction jobs, but once the facility is operational, it creates long-term employment opportunities for healthcare workers, educators and administrative staff. By creating jobs, infrastructure projects help reduce local unemployment, provide income to families and improve overall economic stability.

Moreover, service-oriented projects such as healthcare improvements or social services can significantly empower human capital by improving individuals' access to essential services. Improved healthcare infrastructure, for example, can lead to a healthier workforce, which in turn enhances productivity and reduces absenteeism due to illness.

3. Retention and attraction of talent. Communities with strong infrastructure and high-quality public services are more likely to retain local talent and attract new residents. This is particularly important in rural or underserved areas where "brain drain"—the migration of skilled workers to larger cities or abroad—is a common challenge. By investing in infrastructure such as reliable transportation, modern communication networks and robust public services like healthcare and education, local governments can make their communities more attractive places to live and work.

For example, a town that builds a state-of-the-art public transportation system or expands its digital infrastructure might see a reduction in out-migration as residents recognize the improved quality of life. At the same time, these projects can attract professionals, entrepreneurs and investors from outside the region, further enhancing local human capital.

4. Social and economic inclusion. Infrastructure and service projects often aim to address social inequalities and promote inclusive development by ensuring that all members of the community, including marginalized groups, have access to the resources they need to thrive. This is especially important in post-conflict or post-disaster recovery contexts, where infrastructure projects can play a key role in social integration.

For example, infrastructure improvements in housing, transportation, or social services can be designed to support internally displaced persons (IDPs), people with disabilities, or those from low-income backgrounds, providing them with equal access to opportunities and helping to reduce social disparities. In this way, infrastructure and service projects directly contribute to building a more inclusive and equitable society by enhancing human capital across all segments of the population.

5. Long-term economic growth and sustainability. Finally, infrastructure projects that focus on improving human capital contribute to the long-term sustainability and economic growth of a community. When infrastructure investments are made with a focus on education, healthcare and skills training, the community's workforce becomes more capable, productive and innovative, laying the foundation for sustained economic development.

For instance, a region that invests in sustainable energy infrastructure, combined with education programs focused on green technologies, not only reduces its environmental footprint but also prepares its workforce to participate in the growing green economy. This alignment of infrastructure development with human capital enhancement ensures that the community remains resilient and adaptable in the face of future challenges.

Local human capital is both a source and an objective of infrastructure and service projects, forming a vital link between the community's immediate needs and its long-term development goals. As a source, local human capital provides the workforce, knowledge and innovation needed to implement and sustain projects effectively. As an objective, infrastructure and service projects aim to improve the quality of life, enhance skills, create jobs and foster economic and social inclusion, all of which contribute to strengthening the

community's human capital. By integrating human capital development into infrastructure planning and execution, communities can ensure that these projects yield lasting benefits and build the foundation for future growth and prosperity.

1.6 Selection priority infrastructure and service projects: criteria and stages

Selecting priority infrastructure and service projects involves a strategic process guided by various criteria to ensure that the chosen projects meet the community's immediate and long-term needs, are financially and operationally viable and contribute to sustainable development. This selection process typically occurs in multiple stages, each involving analysis, stakeholder engagement and decision-making to align the projects with broader social, economic and environmental objectives.

Key criteria for selecting priority infrastructure and service projects include:

1. Urgency of needs. Projects that address critical and urgent needs, such as access to clean water, healthcare, transportation, or disaster resilience, tend to receive higher priority. Understanding what the community requires the most helps allocate resources efficiently. High public demand or strong community support can raise a project's priority, especially when stakeholders feel that the project will have a direct, positive impact on their daily lives.

2. Economic impact and viability. Projects that provide a high economic return, such as those that create jobs, stimulate economic growth, or enhance business productivity, tend to be prioritized. Cost-benefit analyses help determine whether the expected benefits outweigh the investment. Infrastructure and service projects that generate employment, both in the short term (construction phase) and long term (operations phase), are often prioritized, particularly in communities with high unemployment rates. Projects must be financially feasible, with clear funding sources and should be capable of generating revenue or providing long-term value to the community.

3. Social and equity considerations. Projects that promote social inclusion, such as those that benefit marginalized groups (e.g., low-income families, disabled individuals, or women) or underserved regions, tend to be prioritized. Projects that directly improve residents' living standards (e.g., healthcare, education, sanitation) receive greater attention. These can significantly impact a community's well-being and social cohesion.

4. Environmental sustainability. Projects with minimal environmental impact or those that contribute to environmental sustainability (e.g., renewable energy, water conservation) are often prioritized. An Environmental Impact Assessment (EIA) helps determine whether a project will harm or help the local environment. Projects that improve a community's resilience to climate change (e.g., flood defenses, drought management) are critical for long-term sustainability and receive higher priority in regions vulnerable to natural disasters.

5. Alignment with strategic plans. Priority is given to projects that align with national, regional, or local development plans and strategies, such as sustainable development goals (SDGs), economic recovery plans, or urban development frameworks. Projects that are in line with government policies, such as decarbonization or rural development initiatives, are more likely to be prioritized, as they complement broader policy objectives.

6. Technical feasibility and readiness. Projects that are technically feasible and can be implemented within a reasonable timeframe tend to be prioritized. Overly complex projects with high risk of delays or failure may be deprioritized in favor of those that can be executed smoothly. Projects that are ready to begin (e.g., with completed designs, permits and funding) often receive higher priority, especially if there are immediate funding opportunities that require quick action.

7. Funding availability. Projects that have secure and accessible funding sources, whether through government budgets, public-private partnerships (PPPs), or international grants, are prioritized due to their financial certainty. Projects that are cost-efficient and offer high value for money tend to be selected over those with excessive costs or unclear funding plans. Affordable

projects reduce the financial burden on governments and communities.

8. Long-term impact and sustainability. Priority is given to projects that are designed to be sustainable in the long term, with clear maintenance plans and manageable operational costs. Projects that require significant future investments to remain functional may be deprioritized. Projects that provide multiple benefits (e.g., infrastructure that serves transportation, economic development and environmental protection) tend to be prioritized over single-purpose projects.

We can also consider the main stages in the selection process of infrastructure and service projects.

1. Needs assessment and stakeholder engagement. The process begins with gathering data on community needs, economic conditions, demographic trends and environmental factors. Surveys, focus groups and public consultations are conducted to understand the priority areas. Engaging stakeholders (community members, businesses, local authorities, NGOs and experts) is critical for identifying local priorities. Their input helps ensure that projects are aligned with actual needs and expectations. A thorough assessment of the existing infrastructure helps identify gaps, inefficiencies and areas in need of improvement. This also highlights potential opportunities for upgrading or expanding existing systems.

2. Project identification. Firstly, different stakeholders (e.g., government departments, private sector, or community organizations) submit project proposals based on the identified needs and opportunities. The initial screening of proposals involves eliminating projects that do not meet basic requirements (e.g., technical infeasibility, non-alignment with strategic goals, or lack of community support).

3. Evaluation of projects. Selected projects undergo detailed feasibility studies to assess technical, financial and operational feasibility. This stage often involves the preparation of a business case, project design, cost estimates and timelines. EIAs and social impact assessments are conducted to ensure that projects will not have significant negative effects on the environment or local communities. Projects with unacceptable risks may be rejected or

modified. A detailed cost-benefit analysis or economic impact assessment is conducted to determine the expected return on investment, job creation potential and long-term economic impact of each project.

4. Prioritization and ranking. Scoring or ranking system based on the criteria mentioned earlier (e.g., relevance, economic impact, environmental sustainability) is used to prioritize projects. Each project is assigned a score or rank based on its potential to meet strategic objectives. In more complex decision-making processes, multi-criteria decision analysis (MCDA) is used to compare projects across different criteria, weighing factors like cost, social impact and environmental sustainability to prioritize those with the greatest overall benefit.

The selection of priority infrastructure and service projects is a multi-stage process that requires careful consideration of diverse criteria, including community needs, economic viability, environmental impact and long-term sustainability. By following a structured process, from initial needs assessment to project monitoring and evaluation, decision-makers can ensure that the most impactful and feasible projects are chosen, providing lasting benefits to the community. This methodical approach helps maximize the effectiveness of infrastructure investments, ensuring that resources are allocated to the projects with the greatest potential to improve quality of life and foster sustainable development.

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2. A COMPREHENSIVE PROFILE OF THE SOCIO-ECONOMIC AND INNOVATION POTENTIAL OF UKRAINE'S BORDER REGIONS IN WARTIME AND POST-WAR PERIOD

2.1 Socio-economic transformations in border regions as a precondition for implementing regional security strategies

The key socio-economic and innovation indicators of the development of Ukraine's border regions have consistently lagged behind those of other regions due to their geographic distance from central regions and the capital, which are hubs of investment and economic activity (Pritula et al., 2019; Baranovsky & Baranovska, 2023). The full-scale russian invasion of Ukraine, the aggressor country's desire to inflict as much damage as possible to Ukraine's human and economic potential, has worsened existing regional development disparities, driven large-scale migration, prompted business relocations away from bordering areas (particularly those neighboring the aggressor state), and disrupted key sectors, including the agro-industrial complex in these areas and logistics links. Continuous monitoring is essential to assess the scope and consequences of these processes on the border regions, as the aggressor state continues active hostilities, adversely affecting all sectors of Ukraine's economy.

The plans for the strategic post-war recovery of Ukraine's border regions are currently being developed, in particular in Kharkiv and Chernihiv regions, to overcome the consequences of full-scale russian armed aggression, restore housing, critical infrastructure, enterprise assets, and create conditions for human development. The Strategy for Economic Recovery and Development of the Border Region of Sumy Region for 2022-2024 envisages the restoration of the region in five priority areas: regional security, industrial complex revitalization, agrarian sector development, human capital enhancement, and economic innovation

(Strategiya vidnovlennya, 2022). However, the proximity to the Russian border, coupled with the ongoing aggressor country's missile and bombing/artillery attacks remains a major constraint to full restoration of the border areas and the return of displaced persons to these territories. Given this, the full implementation of recovery programs will likely follow Ukraine's victory over the aggressor country.

In the context of a full-scale war, the issue of socio-economic and innovative development of the regions directly bordering the aggressor country has gained critical significance due to the heightened risks of territorial loss and regional potential deterioration. For example, Sumy region, bordering Russia's Belgorod, Kursk and Bryansk regions, has the longest state border with the aggressor country among the border regions of Ukraine, which is 564 km. The border areas include 15 territorial communities of the region (Strategiya vidnovlennya, 2022).

Since the beginning of 2021, as a result of administrative-territorial reform, the administrative-territorial structure of Sumy Region underwent significant changes. Prior to the reform, the region consisted of 18 districts and 7 cities of regional subordination. And since 2021, there have been 5 districts in the region – Sumy, Okhtyrka, Romny, Konotop and Shostka, 51 territorial communities, 15 cities, 20 urban-type settlements and 1455 rural settlements (Pro utvorennya ta likvidaciyu rajoniv, 2020). Accordingly, this reorganization altered the demographic distribution in the newly established districts. In terms of administrative-territorial units, the largest population was concentrated in Sumy city and Sumy district, and the smallest number was registered in the newly formed Romny district.

Before the start of the full-scale invasion, the population of Sumy region amounted to 1,035,7 thousand people (as of January 1, 2022) with a pronounced predominance of the urban population (69.8%) over the rural population (30.2%) (Table 2.1) (Golovne upravlinnya statistiki u Sumskij oblasti).

Table 2.1. Population of Sumy Region (number of people)

	as of January 1, 2021		as of January 1, 2022	
	Current population	Resident population	Current population	Resident population
Sumy region	1053452	1051260	1035772	1033580
Sumy district	440618	439913	434316	437467
Sumy city	259660	258858	256474	255672
Konotop District	198238	197546	194408	193716
Okhtyrka District	122146	121625	120107	119586
Romny District	109658	109107	107509	106958
Shostka District	182792	183069	179432	179709

Source: compiled based on data from the Main Department of Statistics of the Sumy region.

In other words, in one year, there was a total decrease of the current population by 17.8 thousand people, largely due to changes in the natural and migration components of the region's demographic development.

The total coefficient of natural population growth (or decline) rate in Sumy Region was -14.8‰ in 2021, and was the highest rate recorded between 2013 and 2021. Sumy region was one of the most migration-active regions of Ukraine even before the full-scale invasion. During 2013-2021 (except for 2016), the region had a negative overall migration growth (decline) rate (Fig. 2.1).

The analysis of the direction of migration processes before the full-scale invasion revealed that Sumy region acted as a labor donor region both for other regions of Ukraine, particularly major agglomerations, and for foreign countries. The region provided these labor markets with a highly skilled yet relatively affordable (inexpensive) workforce, while certain sectors of the region's economy suffered from a shortage of qualified personnel (Hayets, 2022; Savina & Skyba, 2024). Such a decrease in the region's human resources and loss of its intellectual potential undoubtedly led to a decrease in the socio-economic opportunities for the region's development.

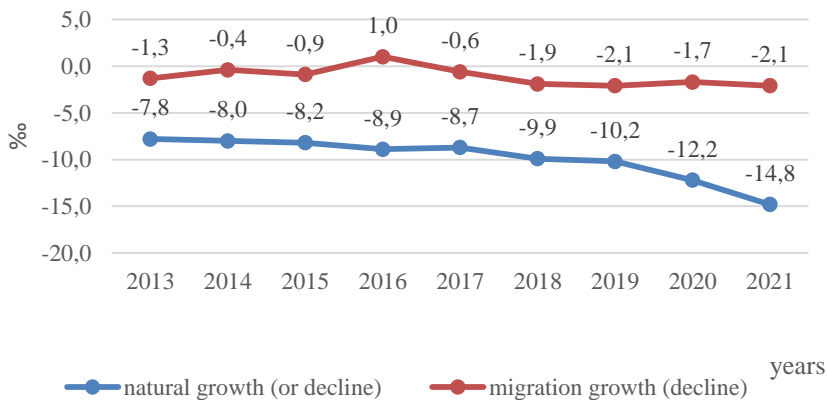


Fig. 2.1. Natural and Migration Growth (Decline) in Sumy Region (per 1,000 population)

Source: compiled based on data from the Main Department of Statistics of the Sumy region.

As of May 2023, the region had registered 82,800 internally displaced persons (IDPs), over 55,000 of whom were internally displaced within the region, primarily from the border communities, where hostilities were (are) taking place, including 21.8 thousand children (Na Sumshini zareyestrovano majzhe 83 tis. pereselenciv).

The largest number of internally displaced persons were from Kharkiv (10,000) and Donetsk (9,000) regions. Half as many IDPs were from Luhansk region (5,000). Internally displaced persons from Kyiv (1.8 thousand people), Zaporizhzhia (1 thousand people), Chernihiv (781 people) and Kherson (545 people) regions were also registered. Compared to other regions of Ukraine, Sumy region is less popular among internally displaced persons, most of whom tried to settle in agglomerations with a high level of socio-economic development and better employment and social integration prospects (Na Sumshini zareyestrovano majzhe 83 tis. pereselenciv).

Traditionally, the region has exhibited strong industrial and agricultural potential. It is well known that the industrial sector plays a key role in establishing a financial foundation to support sustainable economic growth across regions.

In the pre-war period (2021), the total number of operating business entities in Sumy region hosted 41739 units, including 6132 enterprises. Despite the fact that 2021 was a period of strict quarantine restrictions related to the COVID-19 pandemic, the number of enterprises in the region increased by 36, including 3 large and 12 medium-sized enterprises, compared to 2020. The largest share of enterprises was registered in trade (23.2%). The share of enterprises in agriculture, forestry, and fisheries amounted to 20.1%, and industry – 16.2%.

In the context of a full-scale war, agriculture remains a key sector of the region's economy, which affects the standard of living and quality of life. The natural and resource potential for the development of the agricultural sector has been preserved in the region. The region has 392 agricultural enterprises of various forms of ownership, more than 170 food and processing enterprises, 1072 registered farms, 48 agricultural service cooperatives, and 127 thousand households (Strategiya vidnovlennya, 2022).

The region's agriculture is mainly focused on the production of cereals and legumes and sunflower. Sumy region is one of the leading regions in terms of gross production and yield of cereals and legumes, as well as sunflower. The region is ranked first in terms of grain and legume yields, second in terms of sunflower yields, fifth in terms of corn yields, third in terms of gross grain production, and fifth in terms of gross sunflower harvest (Strategiya vidnovlennya, 2022).

Before the full-scale invasion, the Sumy region's business sector achieved a product sales volume of 180437077.3 thousand UAH. In the structure of the volume of products sold by enterprises of Sumy region by type of activity, the largest share belonged to industry (B+C+D+E according to NACE-2010) (38.2% of total sales), in particular, the volume of processed industrial products sold amounted to 68.3% of the volume of industrial products sold in the region in 2021, particularly food and beverage production, which constituted 25.5% of industrial sales.

The volume of agricultural products sold amounted to 28.3%, while the share of goods and services sold in the trade sector amounted to 23.2% of total sales (Fig. 2.2).

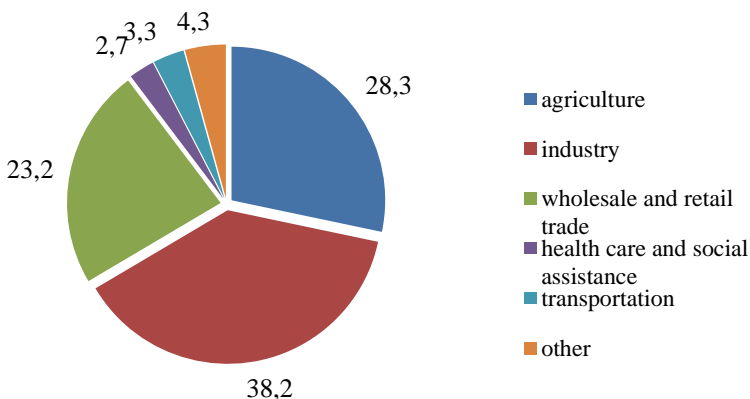


Fig. 2.2. Structure of volumes of products (goods and services) sold by enterprises of Sumy region by type of economic activity in 2021
Source: based on data from the Main Department of Statistics in Sumy Region (Golovne upravlinnya statistiki u Sumskij oblasti)

The index of industrial and agricultural production amounted to 102.0% and 91.6%, respectively, compared to the previous 2020.

Overall, when characterizing the potential of Sumy region, it is evident that the ongoing hostilities have led to destruction and varying degrees of damage to certain enterprises in the area (including infrastructure, equipment, and machinery, among others). Consequently, the full-scale production process, due in part to disrupted logistics (supply and/or distribution channels), and the challenges of securing and fulfilling export contracts, became impossible for an extended period (Strategiya vidnovlennya, 2022).

The defining feature of the national economy is its innovative potential, as it drives economic growth, defense capabilities, and global competitiveness. Innovations, the speed and scale of their implementation will also play a key role in the post-war recovery of the national economy to overcome its technological backwardness (Pisarenko & Kuranda, 2022).

The low level of innovation potential in Sumy region is evidenced by its innovation metrics (Table 2.2). Specifically, the share of expenditures on research and development relative to the gross regional product (GRP) of the region steadily decreased from

1.4% in 2014 to 0.05% in 2019, respectively.

Table 2.2. Innovation Indicators of Sumy Region

Years	1) Share of industrial enterprises that implemented innovations out of the total number of industrial enterprises, %	Number of employees engaged in research and development, units	Expenditures on research and development, total, thousand UAH	Number of introduced types of innovative products (goods, services), units	Share of research and development expenditures in the Gross Regional Product (GRP), %
2010	16,2	2482	25475,2	346	0,1
2011	16,0	3600	54928,1	276	0,2
2012	16,8	3351	142898,8	378	0,6
2013	13,2	3228	43239,5	172	0,2
2014	12,3	3022	422756,4	192	1,4
2015	19,0	2482	43030,6	177	0,1
2017*	15,4	2081	39477,2	217	0,7
2019*	13,1	913	37604,7	201	0,05

Source: Compiled based on data from the Main Department of Statistics in Sumy region

* – the frequency of state statistical surveys on the innovation activity of industrial enterprises was changed from “annual” to “once every two years” starting in 2015 (Golovne upravlinnya statistiki u Sumskij oblasti)

The share of industrial enterprises implementing innovations (in products and/or technological processes) within the total number of industrial enterprises in Sumy region was 13.1% in 2019, which is 2.3% lower than in 2017. The number of types of innovative products introduced into production amounted to 201 units, which is 17 units fewer compared to 2017 (Table 2.2). However, the number

of new technological processes implemented in production increased by 60 units over two years, reaching 285 units in total.

The decline in innovation activity indicators may be attributed to a reduction in the workforce engaged in scientific research and development by 725 people (913 employees in 2019, compared to 1638 in 2017). Notably, the number of employees holding a Doctor of Science degree in 2019 decreased by half compared to 2017.

The total expenditures of enterprises on innovation reached 876,689.7 thousand UAH, of which 37604.7 thousand UAH was allocated for scientific research and development. Funding for industrial enterprises' innovation activities was primarily sourced from their own funds, accounting for 66.6% of total expenditures. The share of state budget funds spent on innovation constituted 32.2% of total expenditures.

Unemployment is a social and macroeconomic issue that poses a real threat to the economic security of the state. In Ukraine, as of 2021, there were 1711.6 thousand unemployed individuals aged 15 and older, exceeding the number of unemployed in the same period of 2020 and 2019 (1674.2 thousand and 1487.7 thousand, respectively). The unemployment rate (according to ILO methodology) was also higher in 2021, reaching (9.8%), compared to (9.5%) in 2020 and (8.2%) in 2019 (Derzhavna sluzhba stitistiki Ukrayini).

A similar trend was observed among the employed population, which decreased by 305.3 and 968.0 thousand people in 2021 compared to 2020 and 2019, respectively. In total, 15,693.4 thousand employed individuals were registered in Ukraine in 2021, representing 49.3% of the total population of the corresponding age.

In the structure of employment of the Ukrainian population by economic activity, the largest share of employed individuals was in wholesale and retail trade (23.1% of all employed persons) (Fig. 2.3).

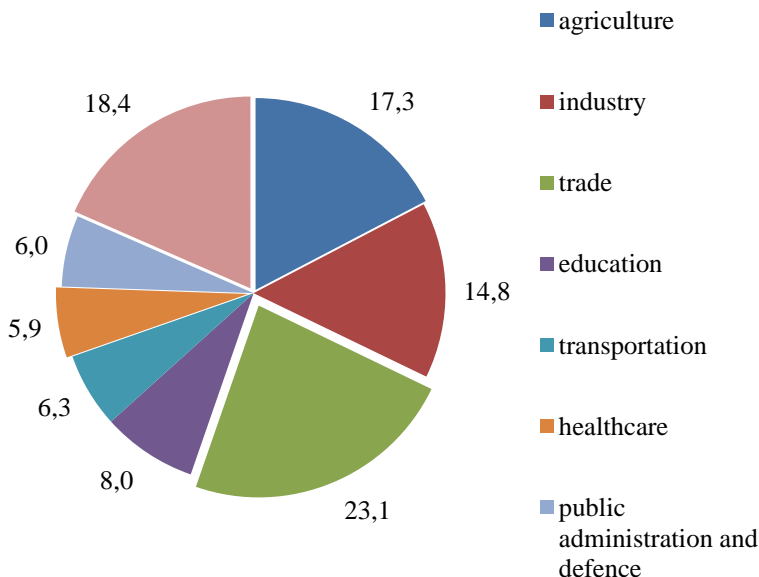


Fig. 2.3. Structure of the Employed Population by Type of Economic Activity in 2021, %

Source: based on data from the State Statistics Service of Ukraine (Derzhavna sluzhba stitistiki Ukrayini).

Slightly smaller share of the population was employed in agriculture, forestry, and fishing, as well as in industry (17.3% and 18.3%, respectively).

The labor market situation in Sumy region showed a tendency toward deterioration, as evidenced by the increase in the number of unemployed people aged 15 and older by 2.0 and 8.6 thousand people in 2021 compared to 2020 and 2019, respectively. Additionally, the number of employed people decreased (444.5 thousand people) compared to 2020 (460.5 thousand) and 2019 (491.8 thousand).

The unemployment rate (according to the International Labour Organization (ILO) methodology) in the region in 2021 (10.5%) was higher than the national level (10.3%). The unemployment rate (ILO methodology) in Sumy region was 9.9% in 2020 and 7.7% in 2019 (Golovne upravlinnya statistiki u Sumskij oblasti).

It should be noted that during the years of the full-scale war

(2022–2023), there was a trend toward a decrease in the number of unemployed people in Sumy region.

According to the employment service in Sumy region, 36.6 thousand people were registered as unemployed in 2022. Compared to 2021, the number of unemployed people decreased by 16.1% (from 43.6 thousand people). In 2023, the number of such people decreased by 35.8% compared to 2022, reaching 23.5 thousand people (Derzhavna sluzhba stitistiki Ukrayini). Nearly half of the unemployed had vocational education (49.0%), while the share of unemployed people with higher education was 41.0%.

By economic activity, the highest numbers of unemployed citizens in 2023 were registered in wholesale and retail trade, repair services (3837 people), public administration and defense (2684 people), manufacturing (2576 people), as well as transport (1336 people) and agriculture (1918 people) (Derzhavna sluzhba stitistiki Ukrayini). The number of registered unemployed in healthcare and social assistance was 1018 people.

The reduction in the share of unemployed people in 2023 was facilitated by the introduction of a mechanism for involving the unemployed in the “Army of Recovery” program, which engaged unemployed individuals in socially useful work needed in the region. Sumy region was among the first to implement this mechanism, allowing for the employment of nearly 400 unemployed individuals in socially useful work across 18 territorial communities where no active combat was taking place. Those employed under this program were primarily engaged in defense-related work, work to eliminate the consequences of man-made, natural and military emergencies, among other tasks.

The psychological and social condition, along with the emotional experiences of unemployed individuals stemming from job loss and prolonged inability to find employment, may lead to a decline in their health. This situation can contribute to the development of circulatory system diseases such as cerebrovascular diseases, hypertension, depressive states, neurosis, alcohol-related psychosis, increased suicide rates, and other conditions. Consequently, this leads to higher household expenses for treating these illnesses, or even premature death if left untreated.

2.2 Human resource and infrastructure support in healthcare system

The human resources potential underpins the operation of all sectors of Ukraine's economy, determining the efficiency and quality of services provided (Lebano et al., 2020; Kaye et al., 2021; Laugesen et al., 2021; Nundy et al, 2022).

The responsibility for ensuring high standards of health, access to medical services, and care for all Ukrainian citizens, as well as disease prevention rests with the healthcare and public health systems.

The healthcare sector's effectiveness depends on its resource base, namely human resources, the number of hospitals, and outpatient medical clinics corresponding to the population's needs and population of Ukraine (Volosovets et al., 2020; Mazur et al., 2021).

Currently, and over recent years, Ukraine has seen a negative trend regarding the quantity of healthcare workforce. In 2021, medical assistance across healthcare facilities of all ownership types was provided by 143 887 doctors across various specialties, while the number of registered full-time medical positions stood at 179 864. That is, the gap between the positions and individual doctors was almost 36 000. Over the past two years, the number of doctors has decreased by more than 10 000 (see Fig. 2.4). Consequently, the physician-to-population ratio decreased from 37.0 per 10 000 population in 2019 to 35.1 per 10,000 in 2021. The staffing rate of registered medical positions by physical persons reached 80.0%, compared to 82.07% in 2019 (Likarski kadry systemy MOZ Ukrainy).

Of all practicing doctors (143 887 individuals), 67.1% held qualification categories, with 42.5% having the highest category. The staffing situation in the sanitary service (public health) remains particularly unsatisfactory. The number of public health physicians (sanitary doctors) was 1130, with 300 sanitation doctors and 218 general hygiene doctors. The number of epidemiologists, disinfectors, and parasitologists totaled 384, with 63.0% having a qualification category.

The number of doctors in the sanitary group was 0.28 per 10 000 people.

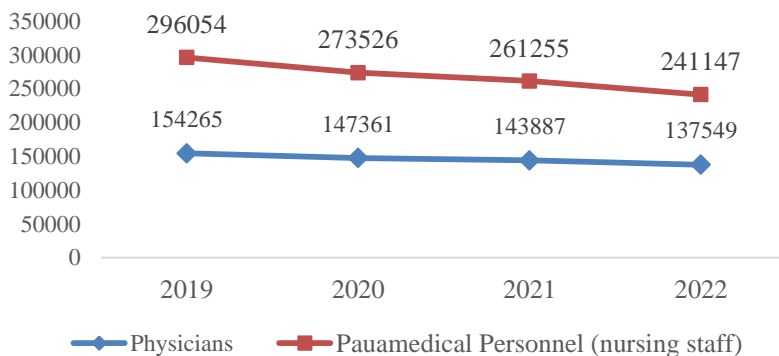


Fig. 2.4. Number of Physicians and Paramedical Personnel in Healthcare Institutions, Ukraine

Source: compiled based on data from the Center of Medical Statistics of the Ministry of Health (*Likarski kadry systemy MOZ Ukrainy*)

The downward trend has also been observed in the number of paramedical personnel (nursing staff) in recent years (see figure 4). In 2021, the number of paramedical personnel was 261,255 individuals (compared to 296,054 individuals in 2019). The gap between registered staff positions and actual paramedical personnel was nearly 36,000. The availability of paramedical personnel in 2021 stood at 63.7 per 10,000 population, down from 70.9 in 2019. The staffing level of paramedical personnel positions with qualified individuals was at 88.5%.

Several factors contribute to the negative trend in the healthcare sector's workforce resources, including a decline in the attractiveness of working in state-run healthcare institutions among young physicians (doctors), higher salaries in healthcare institutions within the European Union (where many of our healthcare professionals seek employment), etc. The cessation of state distribution of specialists trained under government contracts since 2017, along with reductions in the training volumes for physicians and nurses, has also negatively impacted the availability of medical personnel (Volosovets et al., 2020).

The staffing situation in the healthcare sector of Sumy region mirrors the national trend of decreasing medical personnel. In 2021, the number of physicians in Sumy region was 3 672 across all specialties, while the number of registered physician positions totaled 395 675, resulting in a gap of 10 900 between available positions and actual physicians (Fig. 2.5).

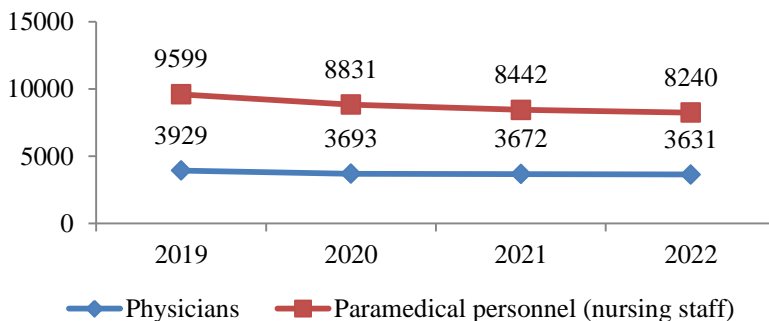


Fig. 2.5. Number of Physicians and Paramedical Personnel in Healthcare Institutions, Sumy Region

Source: compiled based on data from the Center of Medical Statistics of the Ministry of Health (*Likarski kadry systemy MOZ Ukraine*).

The availability of physicians in the region was at the national level, standing at 35.53 per 10,000 population, while the staffing rate of full-time physician positions with physical individuals was nearly 3% lower than the national average (77.1%).

The number of paramedical personnel in healthcare institutions in Sumy region was 8 442 individuals, and the number of registered staff positions was 9 087 (a gap of 644.8 between positions and paramedical personnel).

The availability of paramedical personnel in the region was higher than the national level (63.7 per 10,000 population), at 81.7 per 10,000 population, although slightly lower than the 2019 level for the region (90.0 per 10,000 population). The staffing level of paramedical personnel positions with qualified individuals was 92.9% (compared to 93.1% in 2019).

The supply of paramedical personnel (nursing staff) in the

region was higher than the national average (63.7 per 10,000 population), reaching 81.7 per 10,000 population, though slightly below the 2019 level in the region (90.0 per 10,000 population). The staffing rate for paramedical positions filled by individuals was 92.9% (compared to 93.1% in 2019).

The number of healthcare institutions in the region is also trending downward (see Fig. 2.6).

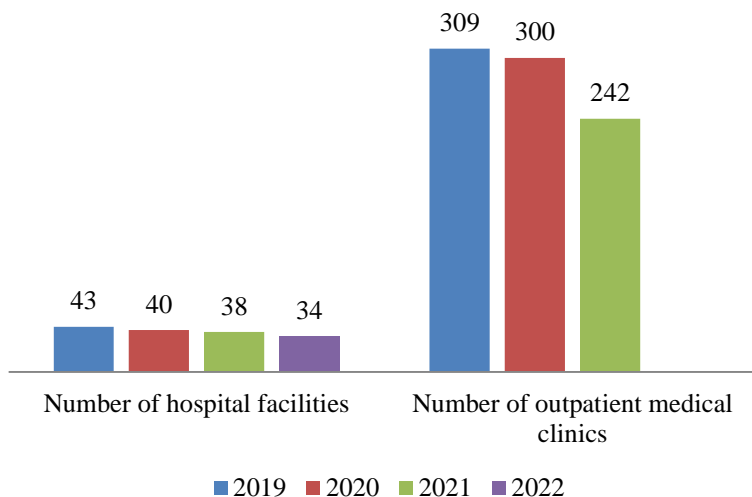


Fig. 2.6. Healthcare Facilities Network of Sumy Region
Source: Compiled based on data from the Center of Medical Statistics of the Ministry of Health.

The healthcare network in Sumy region in 2021 included 38 hospital facilities and 242 outpatient medical clinics.

Analyzing the healthcare workforce during the COVID-19 pandemic reveals that Ukraine faced it with a shortage of personnel, especially paramedical staff, and a dismantled State Sanitary and Epidemiological Service. During the pandemic, healthcare workers played a primary role in combating the dangerous COVID-19 respiratory virus, constantly facing life-threatening risks (Ardebili et al., 2021; Haleem et al., 2021; Haldane et al., 2021; Lupu & Tiganasu, 2022).

Since the pandemic began, over 115,000 healthcare workers worldwide have died from COVID-19 complications while performing their duties.

Against the backdrop of a critical medical staffing shortage during the pandemic, the registered number of unemployed healthcare professionals was one of the highest, reaching 28 400 individuals (compared to 17 000 in 2019), or 6.4%. As of November 1, 2020, there were 27 700 registered healthcare vacancies.

Currently, several key positions remain vacant, including 1354 for general practitioners, 1086 for pediatricians, 784 for surgeons, 763 for obstetricians-gynecologists, 965 for anesthesiologists, 406 for phthysiologists, 3188 for family medicine practitioners, 655 for laboratory doctors, and 911 for dentists (IMF, 2021).

This situation is primarily attributed to the declining attractiveness of public healthcare jobs, especially among young doctors, due to low wages and unsatisfactory working conditions. The cessation of state distribution programs for specialists trained under government orders since 2017 and the reduction in training volumes for doctors and nurses have exacerbated the shortage of medical personnel (Volosovets et al., 2020).

As of January 1, 2020, Ukraine lacked 33 707 physicians and 35 000 paramedical staff. Since April 2020, over 5,000 specialized doctors have left their jobs in Ukraine, with only around a thousand new doctors registered in the electronic healthcare system. Meanwhile, approximately 2,000 doctors and 3,000 nurses from Ukraine applied for jobs through Polish employment agencies.

Urgent political measures are needed to address the shortage of healthcare personnel and prevent further deterioration in the quality of medical care. Without stabilizing the staffing situation, restoring adequate levels of training and retraining, ensuring social protection, and providing safe working conditions for healthcare workers, the standard of medical care for the population will decline, worsening the negative impact on the right to health for the population (WHO, 2020).

Currently, Ukraine is implementing the infrastructure stage of healthcare reform, which aims to restructure the healthcare network by establishing a capable network of healthcare institutions based on

hospital districts.

In early July 2022, the Verkhovna Rada adopted Law No. 2347, which launched the next stage of the healthcare reform – the formation of a capable network of hospitals. To implement the requirements of this Law, the Cabinet of Ministers of Ukraine adopted Resolution No. 174 “Some Issues of Organizing a Capable Network of Healthcare Institutions” on February 28, 2023.

Each region became a separate hospital district, further divided into clusters. Within each district, hospitals are categorized as supercluster, cluster, and general hospitals. In general, the reform envisions that common illnesses will be treated as close to the patient as possible, in general hospitals. For more complex health issues, patients will go to cluster and supercluster hospitals offering highly specialized services.

The reform is expected to enable rational resource allocation in healthcare facilities according to their role in the capable network of the hospital district, including infrastructure upgrades and modernization and the purchase of costly equipment, etc.

From June to July 2023, a list of supercluster, cluster, and general hospitals in the capable network was approved (as of December 20, 2023). Currently, 562 institutions in 19 regions are included in the capable network, of which 123 are supercluster, 157 are cluster, and 282 are general facilities (Spromozhna merezha medzakladiv).

In turn, hospital districts are divided into smaller service areas – hospital clusters. That is, each hospital district has its own unique and capable network of healthcare facilities.

The capable network of medical institutions in Sumy region includes seven super-cluster regional institutions of highly specialized medical care, which should be equipped with modern equipment and provide the widest range of services to patients.

The cluster-level system is represented by six medical facilities (one in each of the districts of the region, except for Sumy region). There are 12 general medical facilities in the network. The main goal of changing the network of medical facilities is to improve the quality of medical care and its accessibility to people (Spromozhna merezha medzakladiv).

An essential condition for the development of the healthcare system is the strengthening of both its human resources and infrastructure. As a result of military actions in Sumy region, more than 3000 infrastructure facilities have been damaged, including 40 healthcare institutions (2 of them were completely destroyed). Preliminary estimates indicate that the damage to hospitals amounts to around 60 million UAH, while the costs of repairing damaged healthcare facilities reach 13 million UAH. The approximate sum required to restore the region's healthcare facilities is around 1.1 billion UAH (Strategiya vidnovlennya, 2022). However, these damage assessments are not final (nor are the sums needed to restore the medical infrastructure), as the region continues to suffer from shelling by Russia, particularly in border areas.

In the context of a full-scale war and martial law, the Verkhovna Rada of Ukraine (Ukrainian Parliament) amended the 2022 State Budget in March 2022, reallocating additional resources to meet the needs of the country's security and defense sectors while leaving the healthcare budget unchanged in nominal terms. Thus, in 2022, a total of 1537,5 billion UAH (31.2% of GDP) was allocated for national security and defense, representing an increase of 1271,9 billion UAH compared to 2021.

Total healthcare expenditures in 2022 amounted to 1843267.8 million UAH, which was 6.8% of total state budget expenditures. Compared to the previous pre-war year of 2021 and the peak COVID-19 pandemic year of 2020, healthcare funding increased by 9.8% (170505.2 million UAH) and by 13.8% (124925.3 million UAH), respectively (see Table 2.3).

However, the share of total budget expenditures allocated to healthcare in 2022 (6.8%) was lower than in 2021 (11.4%) and 2020 (9.7%), with decreases of 4.6% and 2.9%, respectively. This reduction is attributable to the increase in total expenditures dedicated to funding the security and defense sector. A higher share of healthcare spending was observed during the COVID-19 pandemic in 2020, compared to the previous years 2019 and 2018, with increases of 6.3% and 7.4%, respectively, although this growth occurred at the expense of reduced funding for other economic sectors.

Table 2.3. Budget Expenditures of Ukraine and Expenditures Allocated to Healthcare Financing in 2018-2022, Million UAH (by Functional Classification)

Budget Classification Code	Expenditure Categories	Years									
		2018		2019		2020		2021		2022	
		Million UAH	%	Million UAH	%	Million UAH	%	Million UAH	%	Million UAH	%
0100	General government functions (services)	162949,9	16,5	168206,5	15,7	163849,4	12,7	206643,1	13,9	201999,1	7,5
0200	Defense	97024,0	9,8	106627,7	9,9	120374,1	9,4	127527,3	8,6	1142872,4	42,2
0300	Public Order, Safety, and Judiciary	116875,6	11,9	140151,2	13,1	157672,5	12,2	174409,6	11,7	443323,2	16,4
0400	Economic Activities	63600,7	6,5	72365,1	6,7	168889,0	13,1	180989,9	12,1	95368,4	3,5
0500	Environmental Protection	5241,2	0,5	6316,2	0,6	6636,8	0,5	8200,2	0,6	4714,1	0,2
0600	Housing and Utility Services	296,9	0,03	108,0	0,01	88,5	0,01	164,1	0,01	528,6	0,02
0700	Healthcare	22617,9	2,3	38561,6	3,4	124925,3	9,7	170505,2	11,4	184267,8	6,8
0800	Spiritual and physical development	10107,1	1,0	9967,0	0,9	9826,4	0,8	15970,3	1,1	11051,3	0,41
0900	Education	44323,4	4,5	51657,6	4,8	52857,3	4,1	63837,1	4,3	58508,1	2,2
1000	Social protection and social security	163865,6	16,6	218628,6	17,0	322720,3	25,1	339278,9	22,8	425987,0	15,8
	Intergovernmental transfers	298939,7	30,3	260302,0	24,3	160177,1	12,4	202733,3	13,5	136803,3	5,1
	Total	985842,0	100	1072891,5	100	1288016,7	100	1490258,9	100	2705423,3	100

Source: Compiled by the author based on data from the Ministry of Finance of Ukraine (Vydatky derzhavnoho biudzhetu Ukrainy).

The main areas of state budget expenditures were financing of the Ministry of Health of Ukraine (367679.1 million UAH), the State Service of Ukraine on Medicines and Drugs Control (123.1 million UAH) and the National Health Service of Ukraine (157593.6 million UAH), as well as general government expenditures and lending (in the amount of 2431.2 million UAH).

The priority item in the 2022 State Budget's healthcare expenditures was the program of state guarantees for medical services (a list of medical services and medications funded by the state). This program received 157298,2 million UAH, an increase of 22.2% from 2021 (128744.2 million UAH) (see Fig. 2.7). Part of this expenditure was directed toward establishing a baseline salary level for doctors (no less than 20 000 UAH) and for mid-level medical personnel, no less than 13 500 UAH (Vydatty derzhavnoho biudzhetu Ukrainy).

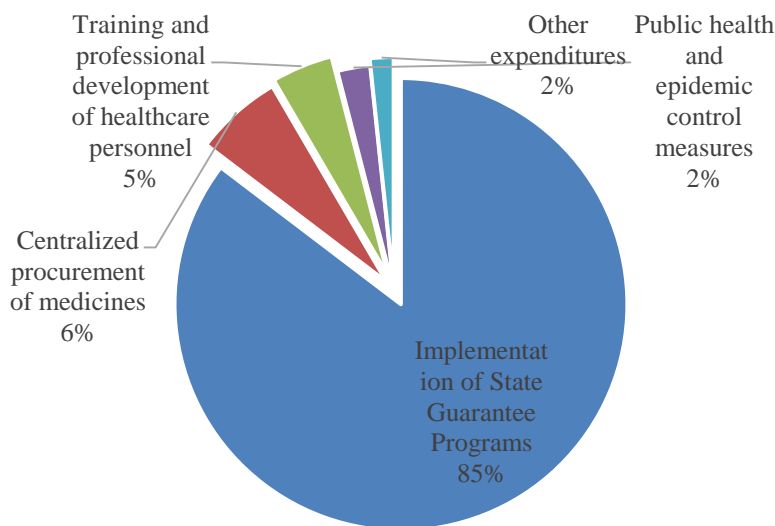


Fig. 2.7. Priority expenditure items of the Ministry of Health of Ukraine envisaged in the State Budget for 2022 (billion UAH)

Source: compiled by the author based on data from (*Finansuvannya okhorony zdorovya v Ukraini, 2022*).

The amount of expenditures allocated for centralized procurement of medicines, medical supplies, and high-cost medical equipment for healthcare facility outfitting totaled 11,534.4 million UAH, representing an increase of 10.1% compared to the previous year's 2021 budget. The state enterprise “Medical Procurement of Ukraine” managed the acquisition of drugs and medical supplies across 25 program areas, covering a total of 816 procurement positions. In comparison, the previous year's orders included 575 items across 21 program areas.

Expenditures for the training and professional development of healthcare personnel, as well as the training of scientific and teaching staff in specialized pre-tertiary and tertiary educational institutions, were set at 8,076.0 million UAH (see Fig. 2.7), which is 14.3% higher than the figure compared to the budget of the previous year 2021. Public health system financing was incorporated into the overall healthcare budget and allocated under the “Public Health and Epidemic Control Measures” budget program. For the implementation of budget program “Public Health and Epidemic Control Measures” in 2022, the allocated funding increased by 64.1% compared to the previous year, rising from 2644,7 million UAH in 2021 to 4339,1 million UAH in 2022 (see Fig. 2.8).

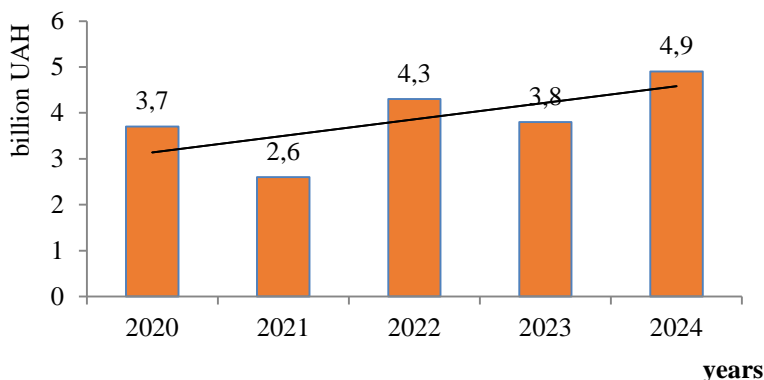


Fig. 2.8. Expenditures for the Budget Program “Public Health and Epidemic Control Measures” in 2020–2024 (billion UAH)

Source: compiled by the author based on data from (*Finansuvannya okhorony zdorovya v Ukrayini, 2022*).

The “Public Health and Epidemic Control Measures” budget program provides funding for all areas of public health, including immunization, prevention of non-communicable diseases, epidemic control, health promotion, HIV/AIDS and tuberculosis prevention, and epidemiological surveillance of infectious diseases. However, experience from the COVID-19 pandemic has highlighted the prioritization of infectious disease components in public health funding over non-communicable disease prevention.

The main sources of financing for Ukraine’s healthcare system are predominantly private household funds, government funds, including taxes and social insurance contributions and funding from international donor organizations – funds from the rest of the world.

The volume of private funds allocated to healthcare remains substantial due to the growing proportion of household healthcare expenditures. The share of direct payments made by healthcare service users, primarily out-of-pocket expenses, aimed at covering healthcare services during 2015–2020 was consistently high, accounting for over 45% of total healthcare expenditures (by funding organisations). Since 2018, there has been a trend toward a reduction in household spending on healthcare, decreasing from 49.7% in 2018 to 46.4% in 2020 (Fig. 2.9).

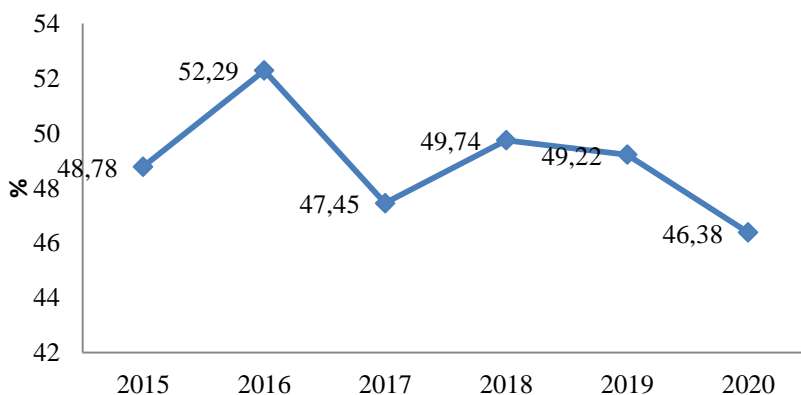


Fig. 2.9. Household (private) expenditure share in total healthcare expenditures, %

Source: compiled by the author based on data from the State

Statistics Service of Ukraine (Derzhavna sluzhba stitistiki Ukrayini).

In 2017 and 2020, the share of government spending in total healthcare expenditures surpassed household spending by 2.2% and 3.5%, respectively.

The implementation of Sustainable Development Goals, particularly the target “Ensuring health and well-being for all”, aims to reduce household healthcare expenditures, including protecting the population from financial risks, improving access to quality primary healthcare services, and providing affordable essential medications through increased healthcare funding. Consequently, the share of household expenditures in total healthcare spending from 2015–2020 reflects gradual progress toward target benchmarks but remains significantly high, underscoring limited accessibility of healthcare services for the population.

The Law of Ukraine “On the Principles of State Regional Policy” identifies four functional types of territories: recovery territories, regional growth poles, territories with special development conditions, and sustainable development territories. In Sumy region, 17 territorial communities across four districts (Shostka, Okhtyrka, Sumy, and Konotop) have been included by the Ministry of Reintegration of the Temporarily Occupied Territories of Ukraine in the list of areas where combat operations have taken place or are ongoing (Pro zatverdzhennya Pereliku teritorij, 2022). Thus, Sumy region’s territorial communities will be a focal point of state regional policy through 2027, prioritizing their recovery and development as border regions in adverse conditions, aligned with the functional territory classifications. However, the restoration and development of most sectors of the national economy of the border regions will take place after the victory of Ukraine. Nevertheless, it is already necessary to analyze and take into account in the future those “pre-war weaknesses” and shortcomings that led to economic weakness, technological and innovative backwardness of the state compared to the EU countries. In addition, the postwar recovery should not be seen as merely returning the economy to prewar levels, but should be aimed at its radical transformation, increasing the rate of growth of competitive positions in all sectors.

Thus, in the context of a full-scale war, our country faces

losses in human, economic, natural resources, infrastructure, production capacity, and the level of competitiveness in general. The hostilities also deepen and exacerbate the existing imbalances in regional development, in particular in the border regions (those directly bordering the aggressor country). Sumy region, as a border region with the longest state border with the aggressor country, exhibited relatively lower key socio-economic indicators than other regions in Ukraine during the pre-war period. relatively lower key indicators of socio-economic development in the pre-war period compared to other regions of Ukraine.

The priority task today is to develop and implement a post-war recovery policy for Ukraine's regions, focused on a thorough transformation of the national economy by creating a new model grounded on the principles of innovative development. This strategy should target sustained growth and improved competitiveness across all sectors, rather than simply restoring the economy to its pre-war state. The focus of the state regional policy on post-war recovery and stimulation of regional economic development, and most importantly, their further protection from the aggressor country, should be on the border regions as regions that ensure the stability of the rear.

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3. CONCEPTUAL FRAMEWORK FOR THE FORMATION OF A SCIENTIFIC CORE IN THE UKRAINIAN BLACK SEA REGION FOR THE BLUE TRANSFORMATION OF THE ECONOMY

3.1 Research infrastructure as a tool for the integration of Ukraine into the European Research Area

Research infrastructure (RI) includes instruments, equipment, information networks, databases, materials and services that serve to facilitate research, promote research collaboration and reinforce research and innovation capacity and know-how (Academy of Finland, 2021).

The following definition for RI from Article 2 (6) of the Regulation (EU) No 1291/2013 of 11 December 2013: `Establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020)` applies: “RI are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. They include: major scientific equipment (or sets of instruments), knowledge-based resources such as collections, archives and scientific data, e-infrastructures, such as data and computing systems and communication networks and any other tools that are essential to achieve excellence in research and innovation.” Accordingly, RI are implemented along different organisational models, including central sources and laboratories for experiments and measurement sessions, coordination and management of geographically distributed observatories or laboratories, remotely accessible resources for computing, data banks, physical sample repositories, surveys and longitudinal studies.

Key objectives are:

- reduce fragmentation of the research and innovation ecosystem;

- avoid duplication of effort;
- better coordinate the development and use of Research Infrastructures;
 - establish strategies for new pan-European, well-established intergovernmental or national Research Infrastructures;
 - join forces internationally to construct and run large, complex or expensive infrastructures, respond to global challenges and/or foster combining skills, data and efforts of the world's best scientists;
 - foster the innovation potential of Research Infrastructures by making industry more aware of opportunities offered to improve their products and by the co-development of advanced technologies;
 - use Research Infrastructures for science diplomacy – using science collaboration to address common problems and build partnerships internationally, e.g. SESAME in Jordan and EU-CELAC in Latin America (European Commission, 2020).

Research infrastructures may be ‘single-sited’, ‘distributed’ (an organised network of resources), ‘mobile’ or ‘virtual’:

- single-sited infrastructure is a single infrastructure / resource available at a single location;
- distributed infrastructure is an infrastructure having facilities located in different sites, operated by one legal entity, or an infrastructure set up as a central hub which is responsible for the coordinated operation of several closely coordinated distributed facilities, which might however retain their legal personality;
- mobile facility involves vehicles or vessels specially designed for scientific research (for example ships, aircraft, etc.);
- virtual infrastructure, or a virtual research environment, implies that the service is provided electronically. Such research environments are considered to be increasingly crucial in maintaining the competitiveness of European scientists in a global context (Regional Cooperation Council, 2020).

It is also useful, when considering a specific RI or facility, to distinguish between capital-bearing (for example buildings and equipment) and non-capital-bearing research infrastructure (people) and between knowledge-bearing (researchers, laboratories, collections, etc.) and non-knowledge-bearing research infrastructure

(support staff, office space, “ordinary” computers, etc.) available to the RI management.

High-quality and up-to-date research infrastructures support innovation activities, international collaboration and networking, mobility and societal interaction.

There are three levels of developing an institute’s research infrastructure: the internal level of an institute, the national level and the international level (Fig. 3.1).

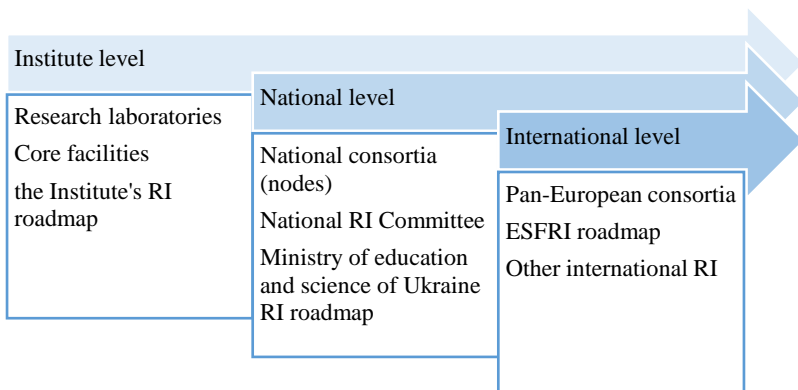


Fig. 3.1. Levels in developing an institute’s research infrastructure

Source: developed by the author

Core facilities at the internal level produce high-quality research services not only for research conducted in units, but also for wider internal use as well as for external partners. It must be noted that as a rule, the research conducted at core facilities is subject to a fee. Consequently, service descriptions and price lists must be up to date and easily accessible. Research infrastructures are designated as core facilities by the research infrastructure committee.

Criteria:

- Possibility to offer services on a large scale to partners outside the unit
- The service concepts and prices are clearly defined
- Paid services to outside partners are possible and routinely offered
- The core facility’s goal may be (partial) self-sufficiency

through paid services

- Support services of various levels are available to users (conducting measurements; collecting, analysing and storing material)

- Maintenance encompasses both human and technical resources, including a long-term development plan (University of Helsinki, 2022).

The national research infrastructure is the research infrastructure of national and/or international importance that promotes the quality of research and education. The national research infrastructure also has an impact on business life and society. The national research infrastructure must have a long-term plan to maintain and develop services. The services and data produced by the research infrastructure must be openly accessible. The national research infrastructure must consider the change needs created by digitalisation and data intensity in its operations. The national research infrastructure must consider the sustainable development goals in its operations. The funding base of the national research infrastructure must be sustainable and cannot rely too much on competitive funding (Academy of Finland, 2021).

The Cabinet of Ministers of Ukraine adopted a range of legislative documents for the RIs development in Ukraine: The Procedure for granting the status of a state key laboratory in the relevant field of scientific research and scientific and technical development (in 2019), The Concept of the State target program for the development of research infrastructures in Ukraine for the period until 2026 (in 2021), The Regulation of the national scientific center (in 2015).

Further steps should be setting up the National RI Committee, elaboration of the National RI Roadmap, implementation of financial tools for the participation of national research infrastructures in international associations of research infrastructures.

A single research institute could be the member of the national RIs consortia (nodes) or to initiate the formation of a new node.

International research infrastructures are a collaborative platform for international RDI activities and they can be used to implement cooperation and scientific diplomacy between different

countries. Large-scale research infrastructures are often collaboratively used across national boundaries, offering collaboration opportunities to both domestic and international researchers and other operators.

International research infrastructures in general require massive investments, especially at the initial stages. No single university has the required resources. Consequently, most projects are undertaken as consortia of several universities or research institutes.

The European Strategy Forum for Research Infrastructures (ESFRI) unites research infrastructures within the Europe. ESFRI provides the European Roadmap for Research Infrastructures that collect the European research infrastructure spearhead projects (ESFRI, 2021). Ukraine is an associated member of the ESFRI.

The European Research Infrastructure Consortium (ERIC) is a specific legal form that facilitates the establishment and operation of Research Infrastructures with European interest. The ERIC community covers five different research domains of the ESFRI Roadmap – energy, environment, health and food, physical sciences and engineering, social and cultural innovation. Much of the science enabled by ERICs addresses the United Nations' Sustainable Development Goals (UN SDGs), tackles grand societal challenges and contributes to research aimed at combating global threats such as the COVID-19 pandemic (ESFRI, 2020).

International research infrastructure memberships are based on agreements between states or organizations that a single research institute could join them.

Thematic ESFRI clusters established through EU-funded projects to address common issues, exchange experience as well as develop and share good practices related to RI development and operation and most recently to strengthen their capacity of linking to the European Open Science Cloud.

The principles of implementing open science at the National Academy of Sciences of Ukraine are defined in the resolution of the National Academy of Sciences of Ukraine dated November 2, 2022 No. 327 "Regarding the participation of the National Academy of

Sciences of Ukraine in the implementation of European principles of open science" and are related to the measures of the national plan for open science, approved by the order of the Cabinet of Ministers of Ukraine dated October 8 2022 No. 892 The development of open science at the National Academy of Sciences of Ukraine takes into account and uses developments in this area of the European Union, including the concept of the European Open Science Cloud (EOSC).

The creation and implementation of a complex centralized open science infrastructure at the NAS of Ukraine will contribute to increasing the productivity of scientific research, the integration of Ukrainian scientists into the European research space, the promotion of scientific results of the NAS of Ukraine and the attraction of international grants (Open science at the NAS of Ukraine, 2024).

DataverseUA is a public platform of the Open Data Repository, available to researchers of the institutes of the National Academy of Sciences of Ukraine for the purpose of hosting, sharing and reusing research data. This helps to ensure the multiple use of research data, its availability, the ability to interact with different types of data and the implementation of operational search (FAIR principles).

The open data repository of the NAS of Ukraine was created within the framework of the implementation of the Target scientific and technical project of the NAS of Ukraine "Creation and implementation of the infrastructure of open science in the NAS of Ukraine (OPENS)" for 2023-2024, which was approved by the order of the Presidium of the NAS of Ukraine dated 02.07.2023 No. 67. The purpose of this project is to increase the presentation of research results of scientists of the National Academy of Sciences of Ukraine in the information environment of open science with the use of modern technical and informational means in the interests of the development of science in Ukraine and international scientific cooperation with the evaluation of such presentation according to certain indicators.

The Open Data Repository of the National Academy of Sciences of Ukraine provides the placement of research data, including documents in digital form, except for scientific publications, which are collected or obtained during scientific

research activities and are used as evidence in the research process and which are necessary to confirm the conclusions and results of research in scientific publications.

The main characteristics of the research infrastructure are presented on the Fig. 3.2.

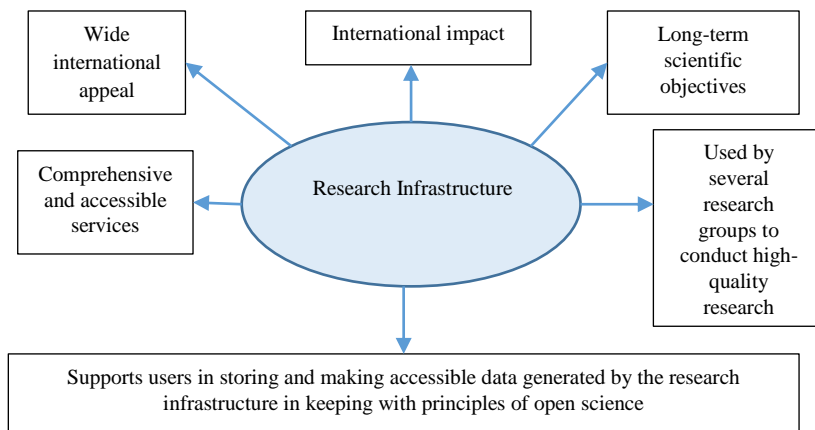


Fig. 3.2. Characteristics of the research infrastructure
 Source: Academy of Finland, 2021

Research Infrastructures and Core Facilities are a vital element for the realization of the European Union as a knowledge-based society. They are at the core of the Open Science and Open Innovation strategy and standing pillars for excellence in science.

3.2 Roadmap for the institute’s research infrastructure development

The provided Roadmap is for Ukrainian research institutes that are specialized in economic and environmental sciences.

At the first stage it is proposed to develop international collaboration with the EU RIs through bilateral memoranda as the activity that can be implemented in a short-term period and positively influence on international presence of the Institute.

At the second stage the facilitation of the Blue Economy national node formation is proposed. This activity requires efforts of all the interested stakeholders and the support of the Ministry of Education and Science of Ukraine that makes it dependable of external factors of success.

The Institute could join the EU RIs through participation in the national nodes and its further integration to the EU RIs, or through bilateral agreements (memoranda) between the Institute and the EU RIs. The first scenario in Ukraine at the initial stage of its formation, thus currently the most possibly scenario is signing a memorandum. Basing on the Institute’s specialization in economic and environmental sciences the European RIs were selected, participation in which is promising (Table 3.1).

Table 3.1. European RIs for Economic and Environmental Science

Name	Full name	Description
<i>Environment</i>		
DANUBIUS-RI	International Centre for Advanced Studies on River-Sea Systems	DANUBIUS-RI is a pan-European distributed research infrastructure supporting interdisciplinary research on River-Sea Systems. DANUBIUS-RI is building a comprehensive suite of complementary services to facilitate excellent research to provide science-based solutions to environmental and societal risks arising from global and climate change. It will be a distributed research infrastructure that brings together world leading expertise and provides access to a range of river-sea systems, facilities and expertise, to provide a ‘one-stop shop’ for knowledge exchange, access to harmonized data, a platform for interdisciplinary research, education and training and hence provide answers to questions regarding sustainable management and environmental protection of the RS continuum.

EMSO ERIC	European Multidisciplinary Seafloor and water-column Observatory	EMSO ERIC is a unique marine multidisciplinary, distributed research infrastructure, with the goal to explore, monitor and better understand the phenomena happening within and below the oceans and their critical impact on the Earth. EMSO brings together diverse and numerous scientific partners, institutes and research centres operating in key sites in European seas, from North East to the Atlantic, through the Mediterranean, to the Black Sea, in a common strategic framework of scientific facilities (data, instruments, computing and storage capacity) to promote and drive advances in marine science and technology while enabling access to its services, facilities and technology platforms.
<i>Health and Food</i>		
AnaEE	Analysis and Experimentation on Ecosystems	AnaEE will link its facilities with an array of user communities, including scientists, land managers, the bio-economy industry and policy makers, with the goal to minimize human environmental impact and maximize societal benefits in a dynamic world.
<i>Social and Cultural Innovation</i>		
OPERAS	Open scholarly communication in the European Research Area for Social Sciences and Humanities	OPERAS is the Research Infrastructure supporting open scholarly communication in the social sciences and humanities (SSH) in the European Research Area. Its mission is to coordinate and federate resources in Europe to efficiently address the scholarly communication needs of European researchers in the field of SSH.
	GoTriple is the service of the OPERAS	GoTriple is an innovative multilingual discovery platform for the social sciences and humanities. It provides one of the central access points for discovering and reusing research artefacts that are relevant to the wide

	variety of disciplines under the umbrella domain of SSH: publications and research data, project descriptions and researcher profiles are automatically imported from aggregators and source providers, semantically enriched and linked in GoTriple.
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Source: developed by the author on the basis of (ESFRI, 2021)

In 2015 the Presidium of the National Academy of Sciences of Ukraine passed the Resolution "On the establishment of the Interdepartmental Coordination Council under the Presidium of the National Academy of Sciences of Ukraine on marine research and improvement of the system of training, retraining and advanced training of scientific personnel in the fields of marine sciences" that was a start of the formation of the Ukraine marine research infrastructure, which core facilities are concentrated in the Odesa region.

The members of the Blue Economy national node could be:

- State Organization “Institute of Market and Economic&Ecological Researches of the National Academy of Sciences of Ukraine” (initiator of the Node formation);
- Institute of Marine Biology of the National Academy of Sciences of Ukraine;
- Ukrainian Scientific Center of Ecology of the Sea (UkrSCES), Ministry of Environment and Natural Resources of Ukraine;
- Odesa State Environmental University (departments: oceanology and marine nature management, atmospheric physics and climatology, etc.);
- Odesa National University named after I.I. Mechnikov (departments: general and marine geology, engineering geology, physical geography and nature management);
- Regional Interdepartmental Center of Integrated Monitoring and Environmental Research of the Odesa National University named after I.I. Mechnikova;
- Odesa National Maritime University;
- Odesa Maritime National Academy;

- State Design Research and Research Institute of Sea Transport "ChornomorNDIproekt";
- Scientific and Research, Design and construction Institute of the Marine Fleet of Ukraine with experimental production (Stepanov, Iermakova, 2022).

The key characteristics of the Blue Economy national node “UKRMARI” are presented in the Table 3.2.

Table 3.2. Formation of the Blue Economy national node (UKRMARI)

Characteristics of the UKRMARI	Description
Facilitator	State Organization “Institute of Market and Economic&Ecological Researches of the National Academy of Sciences of Ukraine”
Aim	Activation of maritime research in Ukraine based on the mobilization of scientific, technical and resource potentials of the maritime research institutions
Potential members	<ul style="list-style-type: none"> – State Organization “Institute of Market and Economic&Ecological Researches of the National Academy of Sciences of Ukraine”; – Institute of Marine Biology of the National Academy of Sciences of Ukraine; – Ukrainian Scientific Center of Ecology of the Sea (UkrSCES), Ministry of Environment and Natural Resources of Ukraine; – Odesa State Environmental University (departments: oceanology and marine nature management, atmospheric physics and climatology, etc.); – Odesa National University named after I.I. Mechnikov (departments: general and marine geology, engineering geology, physical geography and nature management); – Regional Interdepartmental Center of Integrated Monitoring and Environmental Research of the Odesa National University named after I.I. Mechnikov; – Odesa National Maritime University; – Odesa Maritime National Academy; – State Design Research and Research Institute of Sea Transport "ChornomorNDIproekt"; – Scientific and Research, Design and construction Institute of the Marine Fleet of Ukraine with experimental production

Legislation basis	Resolution of the National Academy of Sciences of Ukraine "On the establishment of the Interdepartmental Coordination Council under the Presidium of the National Academy of Sciences of Ukraine on marine research and improvement of the system of training, retraining and advanced training of scientific personnel in the fields of marine sciences"
Further steps	<ul style="list-style-type: none"> – signing the statute of the Consortia – receiving the national status as a National scientific center – membership in the EU RIs
EU RIs for membership	EMSO ERIC, JERICO RI

Source: developed by the author

As an example for this Ukrainian national marine research node and its international integration is the case of the Finnish Marine Research Infrastructure, that provides blue economy research, facilitates the Blue Growth potential of coastal seas, could be used (Fig. 3.3).

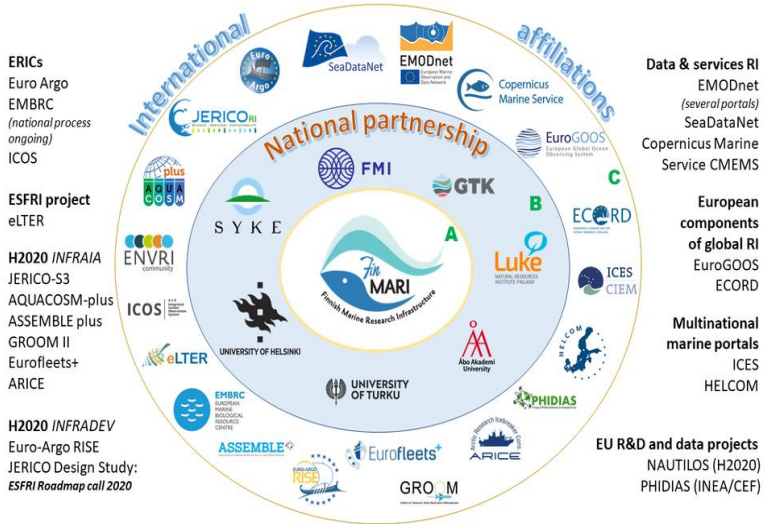


Fig. 3.3. FINMARI – Finnish Marine Research Infrastructure
Source: FINMARI, 2024

The basic aim of FINMARI is to assemble Finnish marine

research infrastructure into a coherent framework and connect it to the RI networks on national and international levels in order to:

- promote the international use of FINMARI RI;
- facilitate the Finnish scientists in utilizing European marine RI;

RI;

- increase the international collaboration in studies of coastal sea Grand Challenges;
- improve the transnational links between academia, industry and society and providing sites for multisectoral studies;
- contribute to a long-term impact through provision of data and products (FINMARI, 2024).

Through wide collaboration at the European scale, FINMARI strengthens the impact of Finnish marine research on the leading international level. FINMARI has been actively involved in the development of JERICO-RI for European Coastal Observatories during 3 successive INFRAIA project stages (2011-present). In 2020, JERICO-RI applies for ESFRI Roadmap and has already funding 2020-2023 for Design Study.

In the experimental AQUACOSM-RI, FINMARI contributes to the joint studies along environmental and geographical gradients. Both JERICO-RI and AQUACOSM-RI projects include Transnational Access programs, through which several international groups have accessed FINMARI facilities for sensor developments and leading-edge research.

FINMARI is well presented also in various other H2020-funded marine RI projects. EUROFLEETS is an EU RI initiative facilitating open free-of-charge access to an integrated and advanced marine research vessel fleet. EU marine data portals and aggregators have a key position in the provision of open access to marine data and in providing data products and services. FINMARI is well positioned in these RIs, especially by the research institute partners.

FINMARI partners have long and widely collaborated with the well-established international organizations ICES – International Council for the Exploration of the Sea and HELCOM – The Baltic Marine Environment Protection Commission – also known as the Helsinki Commission, which are fluent in data services, knowledge

creation and in providing scientific advice.

For the Ukrainian Blue Economy national node the cooperation with the described RIs, innovation platforms, international and global organizations are prospective. To the specified list could be added the aquaculture innovation platforms, such as AKIS, European Sturgeon Research Network, AQUAEXCEL3.0, European Aquaculture Society and other.

The purpose of the proposed concept of the Ukrainian Blue Economy national node is the preventive activation of maritime activities in the countries of the Black Sea region based on the mobilization of scientific, technical and resource potentials of the maritime research institutions, aimed at solving the following strategic tasks:

1) Fundamental and applied marine research development in the basin of the Black and Azov Seas, other areas of the World Ocean (including in the Arctic and Antarctic); data collection and processing systems, satellite oceanographic and meteorological systems; equipping maritime organizations with modern research vessels, underwater vehicles, including unmanned ones), floating platforms; development of radiographic methods of studying the marine environment; improvement of weather forecasts based on more complete consideration of marine environment;

2) Maritime transport development due to increase in the tonnage of the transport fleet, development of Black Sea ports for its service, improvement of navigation, hydrographic and hydrometeorological support (including with the help of artificial Earth satellites);

3) Revival and intensification of national and ocean fishing based on increasing the number of the fishing fleet, development of new fishing areas (including Antarctica), development of marine fishing infrastructure (ports, seafood processing and storage bases); industrial breeding of valuable species of biological resources, development of aquaculture;

4) Extraction of mineral and energy resources of the seabed, primarily oil and gas, construction materials, etc., in the future – gas hydrants, iron-manganese nodules, metal-bearing precipitation, etc.; creation of a system of wind, solar and wave power plants along the

coast of the Black and Azov Seas;

5) Industrial cooperation in shipbuilding, creation of the necessary conditions for the effective functioning of shipbuilding in the countries of the Black Sea region in all directions, including military shipbuilding;

6) Marine recreation economy (a complex of resort-recreational and tourist organizations) in the Black Sea region;

7) Environmental safety of the sea coastal zone and coastal water areas within the Black and Azov seas;

8) Formation of a system of integrated management of marine sciences, marine research and the maritime complex based on the creation of effective organizational, economic and legal mechanisms in connection with the international instruments for the regulation of maritime activities (including naval activities, underwater archaeology, preservation and use maritime heritage), personnel training, etc.).

The implementation of the proposed Blue Economy national node concept will ensure:

- the formation of the international status of the Ukrainian Black Sea region as a scientific one;

- integration and activation of scientific, technical and production potential of the country;

- raising the technological level of adjacent and connected industries, increasing the competitiveness of products of the maritime complex and the economy in general;

- expanding and increasing the level of scientific, technical and economic international cooperation in the Black Sea region.

A significant direction in this regard should be the formation of zones of priority development of the maritime science (technopolises, innovation centers, technology parks and other scientific and industrial complexes together with entities of industrial and social infrastructure that ensure their functioning), which should ensure technological breakthroughs and bringing competitive products of maritime enterprises to the market. The creation of zones of this type should be initiated by the seaside regions (Burkynsky, Stepanov, Stepanova, 2018).

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4. SOCIO-GEOGRAPHICAL FEATURES OF THE DEVELOPMENT OF THE EDUCATIONAL AND CULTURAL INFRASTRUCTURE OF SUMY REGION

4.1 Development of educational services infrastructure in Sumy region

Education is an important component of the service sector that contributes to raising the intellectual and cultural level of the population both nationally and in individual regions (Hussein, 2024). The availability of high-quality educational institutions ensures a high level of training, which affects the competitiveness of the region at the national and international levels (Akylbekova, 2024). It also helps to improve the general educational level of the population (Doschanov, 2023).

Accordingly, the availability of educational services to the population is a key condition for the successful cultural, social and economic development of regions. Educational infrastructure is important when analysing the quality of educational services. The development of educational services directly depends on the availability of educational institutions and their territorial accessibility.

According to the SOVA, as of the end of April 2023, 17 territorial communities in Sumy region are in the zone of active and possible hostilities. There are 171 educational institutions in these areas, where 25.7% of the region's students study. Currently, the majority of educational institutions in Sumy region (57.5%) have introduced a mixed form of education, with 38.7% of students studying fully remotely and 3.6% studying full-time. As a result of the hostilities, as of 12.04.2023, 26 preschool educational institutions were damaged and 13 were restored. General secondary education institutions were heavily damaged – 56, 24 were restored. The military invasion affected 10 vocational education institutions, 10 professional higher education institutions and 4 children's health and

recreation facilities. Of these, 3, 3 and 1 institutions were restored, respectively. As of 13.04.2023, 68 educational institutions needed to be restored (Kasat, 2023).

Preschool educational institutions. The first step towards the formation of a conscious, cultural personality is preschool education (Hari, 2024). In the late twentieth century and early 2000s, Ukraine experienced a significant decline in the birth rate, so most preschools were re-profiled or closed altogether. During the period of birth rate growth, problems with preschool education arose, namely the lack of institutions of this type in settlements and the number of places in the remaining institutions.

As stated in the monograph (Geography, 2021), in terms of the level of provision of pre-schoolers with preschool education institutions, Sumy region in 2020 was ranked 13th among other regions of Ukraine. The provision of preschool educational institutions was 13 institutions per 1000 people. In terms of the number of children receiving preschool education, the region ranked 20th among the regions of Ukraine (excluding the temporarily occupied Autonomous Republic of Crimea, Luhansk and Donetsk regions). As of 01.01.2020, Sumy region ranked 1st among the regions of Ukraine in terms of preschool education coverage (73% of children), including 4th in terms of urban children coverage (86% of pre-schoolers) and 7th in terms of rural children coverage (44%).

An important indicator of the development of preschool services is the number of places for children in preschool education institutions. Among other regions of Ukraine, Sumy region in 2020 ranked 10th by this indicator, including 10th place in city institutions and 8th place in rural ones.

According to statistics (Institutions, 2024), as of 2023, there were 389 preschool education institutions in Sumy region. As can be seen from the figure, the number of educational institutions before 2006 was 414 and this figure was the lowest during the study period. At the same time, from 2006 to 2012, there was a slight increase in the birth rate in the region, which is associated with several factors. Among the factors that contributed to the increase in the birth rate during this period is the fact that there were certain improvements in the socio-economic situation in the country as a whole, among the

mothers who gave birth were women born in the 1980s, when the birth rate was high and an important incentive to have children was the introduction of financial assistance after the birth of a child. Accordingly, due to the increase in the birth rate, there was an increase in the number of facilities until 2013. With the outbreak of military operations by the Russian Federation, starting in 2014, the birth rate began to decline and accordingly, the gradual closure of preschool education institutions began. As can be seen from Fig. 4.1, this process has particularly intensified in recent years, due to the fall in birth rates due to the war and mobilisation and the forced migration of the population to safer areas. In general, over the past 10 years, the number of preschool education institutions in the region has decreased by 7.3%.

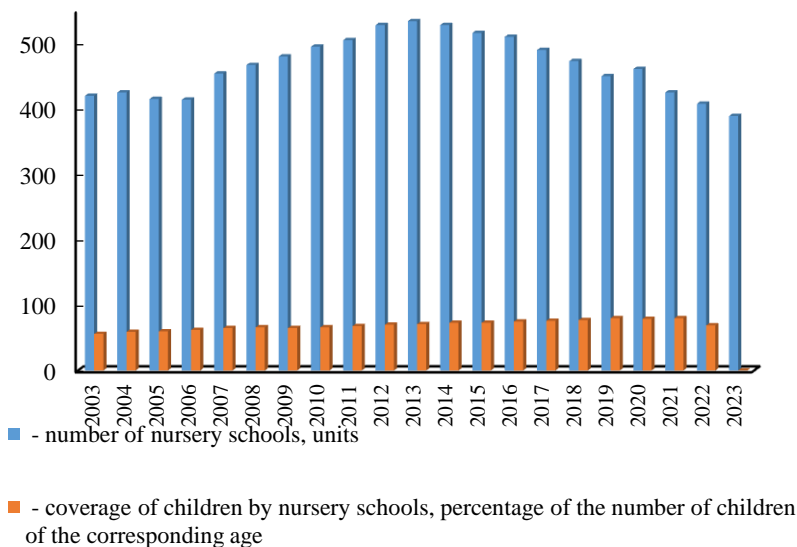


Fig 4.1. Dynamics of preschool education institutions and coverage of children by these institutions in Sumy region

Source: based on data from *Preschool, 2024*

As of 2022, Sumy (1.22) and Okhtyrka (1.05) districts were leading in terms of the index of territorial concentration of preschool

educational institutions in Sumy region. In 3 districts, I_{ic} is less than 1: Konotop – 0.95, Romny – 0.98 and Shostka – 0.82. Accordingly, if we have a value less than 1, then these districts have a lower concentration of preschool education institutions compared to the average region level.

Based on the statistical data of 2022, we calculated the index of territorial concentration of preschool educational institutions in the territorial communities of Sumy region. It was found that in such communities as Buryh city community, Kyrykivka rural community, Sad village community, Dubovyazivka rural community, Nedryhailiv rural community, Shostka city community, Romny city community, Komyshe village community, Druzhba city community, Bezdryk village community, Vorozhba city community, Hlukhiv city community, Miropillia village community, Stepanivka rural community, Sumy city community, Okhtyrka city community and Konotop city community have a coefficient above 1, which indicates a high concentration of these educational institutions. According to the calculations, the lowest concentration of preschool education institutions is in Vilshana village community (0.22), Bochechky village community (0.29) and Znob-Novgorodske rural community (0.36) (Fig. 6).

When analysing preschool services, it is also worth considering such an indicator as the number of places in preschool institutions. As can be seen from Fig. 8, the availability of places in 2003-2023 was fluctuating. Until 2018, this indicator gradually increased and reached its highest value of 33 812 places. However, since 2019, there has been a decline in the number of places. This process deepened after Russia's full-scale invasion of Ukraine. As of 2023, there were 28 687 places in the region. The decrease in places is due to a decline in the birth rate and the absence of children in preschools (Fig. 4.2).

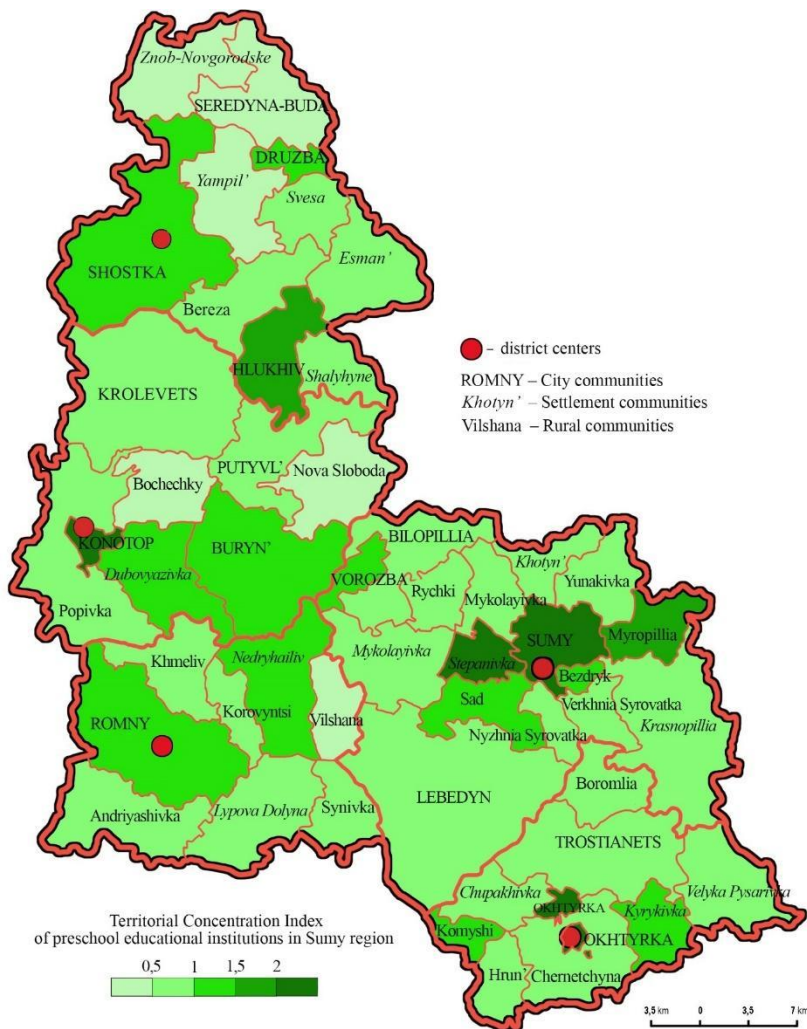


Fig. 4.2. Territorial Concentration Index of Preschool Education Institutions in Sumy region

According to statistics, at the beginning of 2023, 23 668 preschoolers were enrolled in kindergartens in the region. Analysing the dynamics of the number of children in preschool education institutions, we see that the largest number of children was registered

in 2014 and amounted to 37 825 children. Further, we see a gradual decrease in the number of preschool children and as of 2023, the lowest figure is recorded (Fig. 4.3).

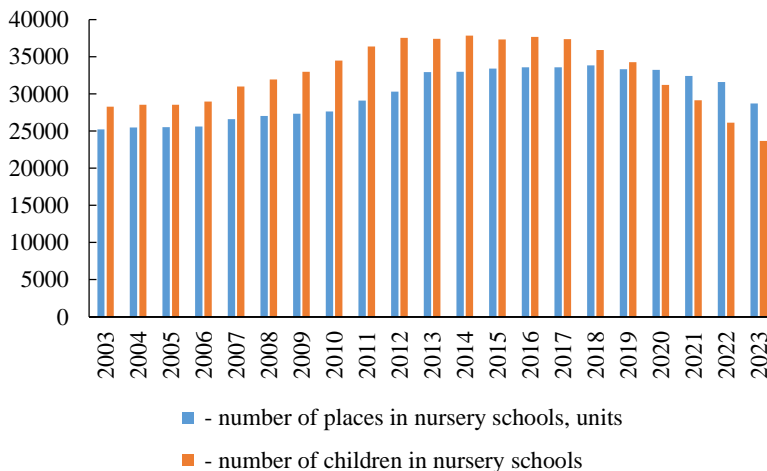


Fig. 4.3. Dynamics of the number of places in preschool education institutions and the number of children in them

Source: based on data from *Preschool, 2024*

An important indicator of the level of development of preschool services is the coverage of children with preschool education. As can be seen from Fig. 4.3, in 2022, preschool enrolment in Sumy region was 69%, while before the full-scale war, this figure reached 80% and was the highest in the last 10 years.

One of the indicators that shows the level of development of preschool education is the social density of this type of service. The social density of services gives an idea of the territorial dispersion of educational institutions and their correspondence to the settlement network.

Analysing the social density coefficient by individual districts, we can see that in Konotop district, the highest value is observed in the Konotop city community and the lowest – is in the Nova Sloboda village community, where there are 4 preschool education

institutions per 37 settlements (Fig. 4.4).

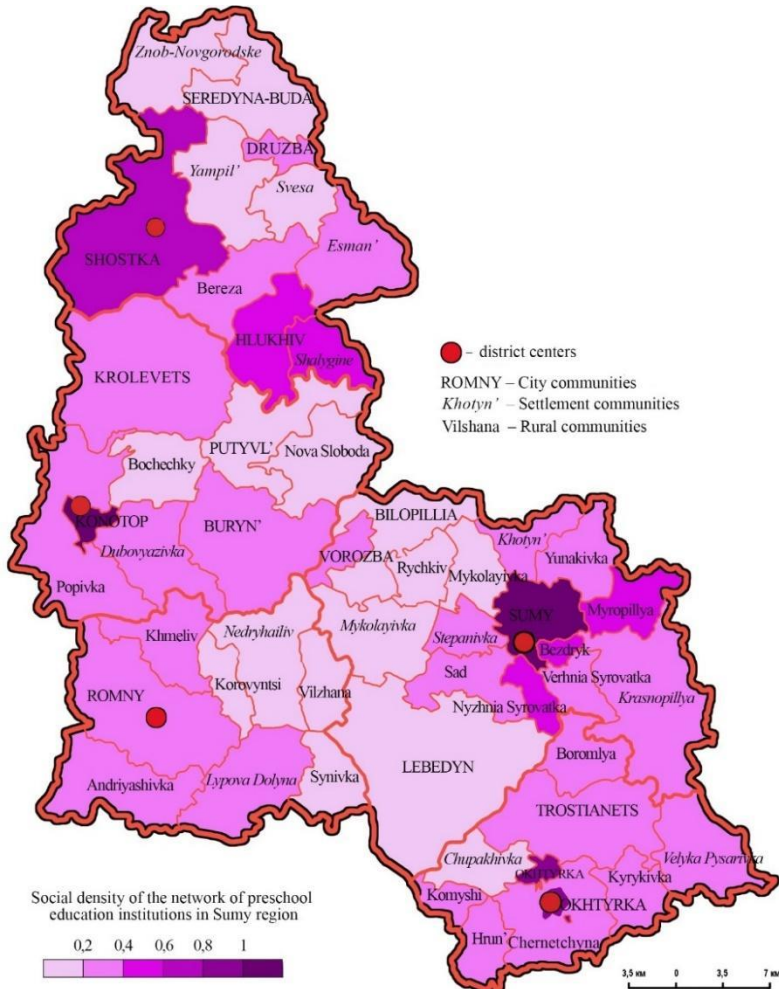


Fig. 4.4. Social Density of the Network of Preschool Education in Sumy region

In the Okhtyrka district, the highest social density ratio is observed in Okhtyrka city community and the lowest ratio is in Chupakhivka rural community, where there are 3 preschool

education institutions per 22 settlements.

For Romny district, the highest social density coefficients are recorded in Romny city andriyashivka village community and Lypova Dolyna rural community and the lowest – in Vilshana village community (1 institution per 22 settlements). In general, the social density ratio of preschool service institutions is relatively low for the communities of this district.

In the Sumy district, the highest social density ratio is observed in the Sumy city community, where there are 38 institutions per 21 settlements. Bilopillia city community has the lowest social density indicator, with only 7 preschool education institutions serving 54 settlements.

In Shostka district, Shostka city community has the highest social density coefficient and the lowest is observed in Yampil' rural community. In this community, there are 4 preschool education institutions for 32 settlements.

As we can see, the highest values of the social density coefficient of preschool services are characteristic of communities where the administrative center of the district is located.

General secondary education institutions. The Law of Ukraine “On Complete General Secondary Education” dated 16.01.2020 No. 463-IX stipulates that every child has the right to receive primary and basic secondary education in the most accessible and closest educational institution to his or her place of residence. The territorial accessibility of full general secondary education is ensured by state authorities and local self-government bodies within their powers, as is the case in many countries around the world (Ma, 2024; Fufa et. al, 2024). Local governments are responsible for creating and maintaining a network of educational institutions and their branches.

As of 05.09.2021, according to the State Education Quality Service in Sumy region, there are 413 general secondary education institutions with 95 554 students (Unified, 2024).

According to statistics, in the Sumy region (General, 2024), over the past 10 years, the number of general secondary education institutions has decreased by 13.4% and the number of students by only 6.1%. It should be noted that in the 2020/21 academic year, the largest number of students studied in these institutions – 98.7

thousand people. This was followed by a decline in the number of students, which intensified during the war, due to forced migration to safer regions of Ukraine and people leaving the country. In the 2023/24 academic year, 92.5 students were enrolled in these institutions (Fig. 4.5).

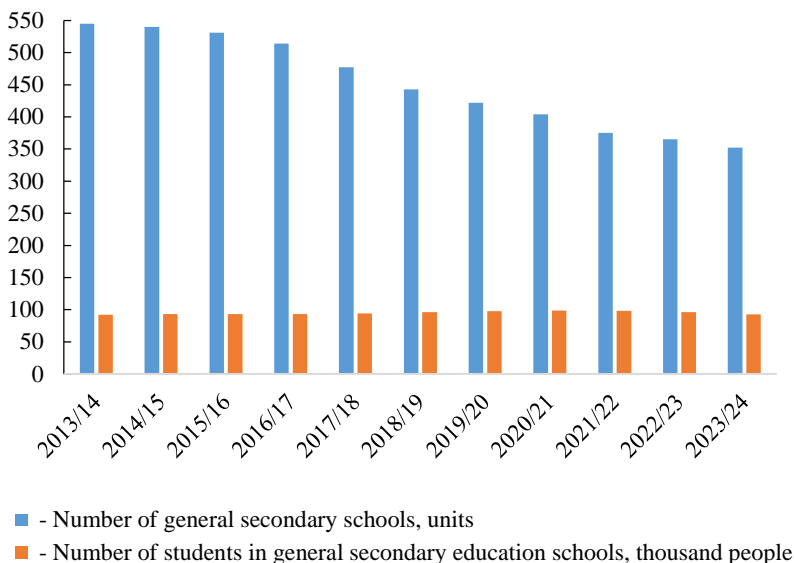


Fig. 4.5. Dynamics of the Number of General Secondary Education Institutions and the Number of Students in them (based on data from General, 2024)

Taking into account the fact that during the period of martial law the state statistics authorities suspended the publication of statistical information, the data from the Unified State Electronic Database on Education was used to analyse the territorial features of general secondary education institutions (Unified, 2024). According to this data, there were 414 educational institutions in the region at the beginning of the 2021/2022 school year. Among the districts, the largest number of them was in Sumy district. The fewest institutions provided educational services in Romny and Okhtyrka districts (Fig. 4.6).

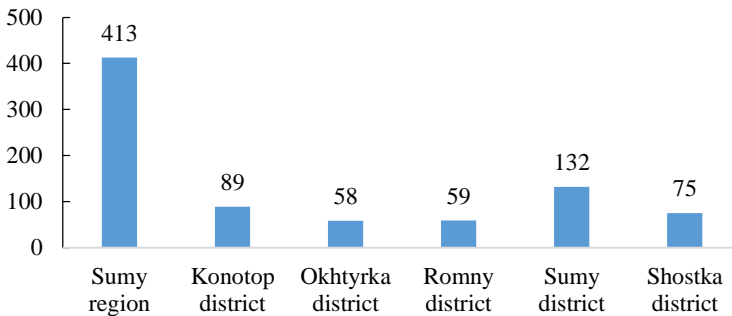


Fig. 4.6. Number of General Secondary Education Institutions in Sumy Region at the Beginning of the 2021/2022 academic year
Source: Unified, 2024

To assess the saturation of general secondary education institutions in different districts of the Sumy region and to determine whether the number of educational institutions corresponds to the existing settlement network, the territorial concentration index and the social density coefficient of these institutions were calculated (Fig. 4.11). As can be seen from Fig. 4.1, Sumy and Okhtyrka districts have a territorial concentration index above 1.0, which indicates the optimal location of institutions in these districts. The social density indexes in terms of districts are approximately at the same level of 0.2-0.3.

In Konotop district, Konotop city community has the highest I_{tc} , with 14 general secondary education institutions per 4 settlements. In all other communities of the district, this indicator is below 1.0 (Fig. 4.7). The lowest I_{tc} is in the Bochechky village community.

In the Okhtyrka district, Komyshi village community and the Okhtyrka city community have a higher I_{tc} than one; the lowest is in Chupakhivka rural community.

Among the communities of Romny district andriyashivka village community and Romny city community have an I_{tc} above one, while Vilshana village community has the lowest score among the communities of this district.

In Sumy district, the following communities have an index

above 1.0: Bezdryk village community, Bilopillia city community, Vorozhba city community, Mykolaivka village community, Miropillia village community, Sad village community, Stepanivka rural community and Sumy city community. Lebedyn city community has the lowest I_{tc} value, with 19 general secondary education institutions per 125 settlements.

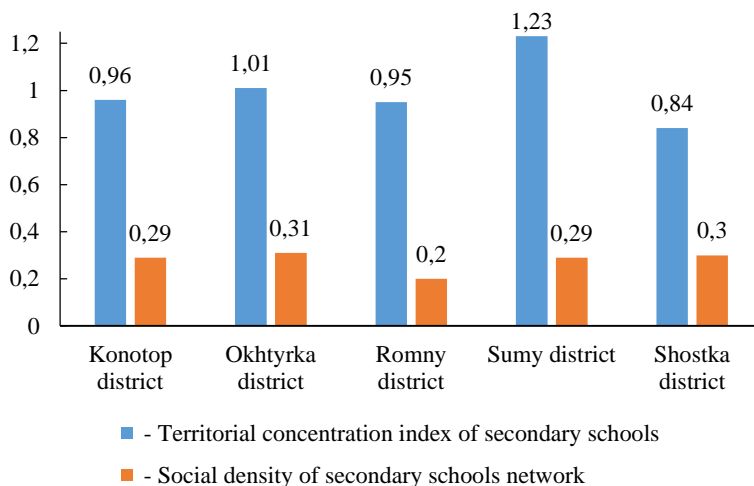


Fig. 4.7. Territorial Concentration Index and Social Density of Secondary Schools Network

Analysing the situation with the territorial concentration of general secondary education institutions in Shostka district, three communities have an indicator above 1.0. This includes 3 city communities: Hlukhiv, Druzhba and Shostka. Znob-Novgorodske rural community has the lowest indicator, where there are only 3 general secondary education institutions for 29 settlements (Fig. 4.8).

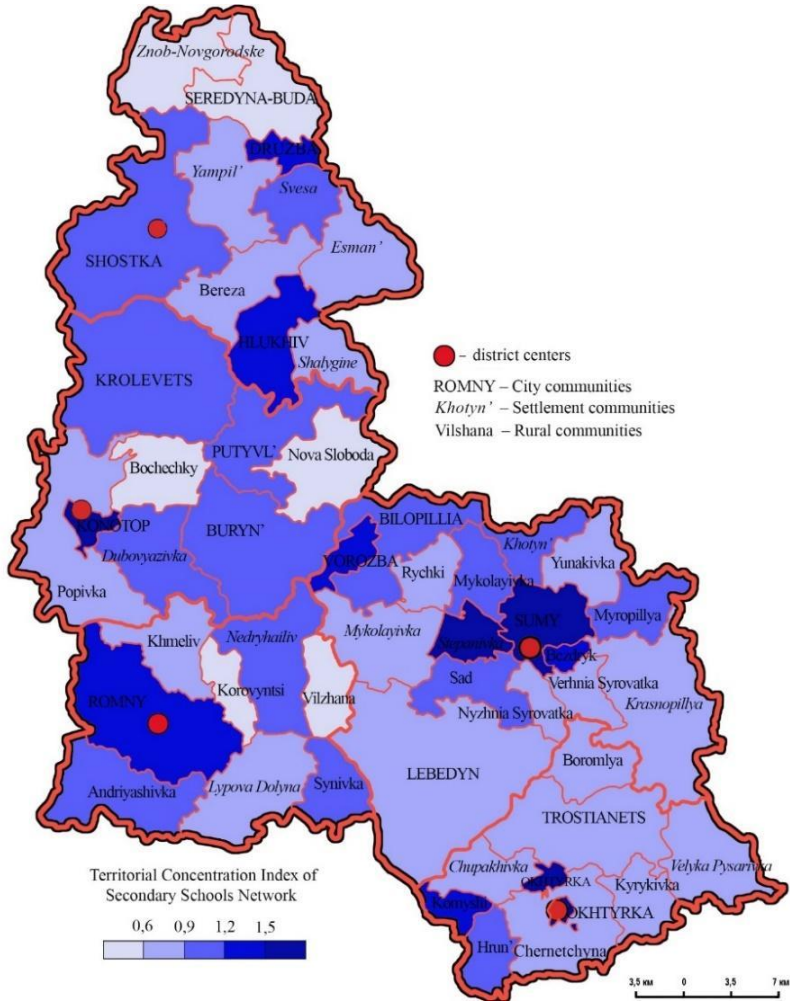


Fig. 4.8. Territorial Concentration Index of Secondary Schools Network

To study the level of development of general education in the region, we also calculated the social density of services. The social density analysis allows us to identify areas with insufficient service provision and direct resources to create new social infrastructure facilities there. This helps to ensure more equal access to necessary

services for all citizens, regardless of their place of residence. This indicator is important for planning and managing territories. It can be used to make decisions on the construction of new schools, hospitals, cultural centers, transportation infrastructure, etc. The calculation of the social density of services allows us to take into account the social aspects of the development of territories, ensuring fair access to services for different groups of the population, including vulnerable categories (pensioners, people with disabilities, children). Regular monitoring of the social density of services helps to assess the dynamics of changes in the quality of life in different regions. This is important for making strategic decisions to improve the living conditions of the population.

This indicator is calculated using the following formula:

$$SD = \frac{EI}{PA}, \quad (4.1),$$

where SD – is the social density of the network of educational institutions; EI – is the educational institutions; PA – is the populated areas.

If one district has a low social density of educational institutions (e.g., few schools), this may indicate the need to build new schools or reconstruct existing ones to meet the needs of the population. Thus, the calculation of the social density of services is an important tool for ensuring accessibility, equal distribution of resources and improving the quality of life of the population.

This indicator allowed us to assess how accessible social services are to the population in different territorial units. According to our calculations, 25 communities have a low social density of Secondary Schools Network. As you can see from the figure, only Sumy city and Konotop city communities have a social density above 1.0. Okhtyrka city community also has a coefficient of 1.0 (Fig. 4.9).

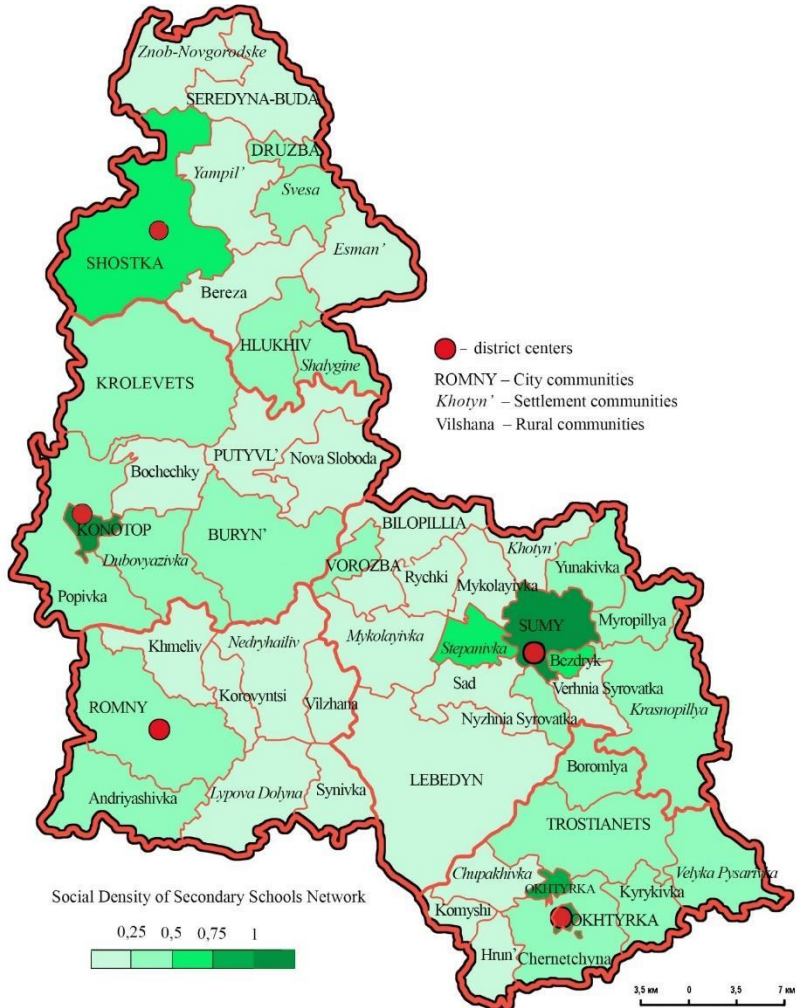


Fig. 4.9. Social Density of Secondary Schools Network

Extracurricular education provides for the development of interests, abilities and talents of children and young people outside of general education. It includes a variety of educational programs, sections, circles, clubs and courses aimed at the comprehensive development of the individual.

The main goal of out-of-school education is to ensure the harmonious development of a child's personality, creativity and intellectual and physical abilities, as well as to promote social skills and civic consciousness formation. It helps to educate a person who can actively participate in society, think critically, work in a team and take initiative. It helps to identify professional interests and future career choices by allowing children to try out different roles and areas of activity, which can influence their future career choices.

The role of out-of-school education should be reassessed. As noted in the article by S. Londar et al. (Londar, 2023), in the conditions of war, it is the out-of-school education institutions in all regions of Ukraine that have been working to create all possible conditions for the availability of such education to children from families who have found themselves in difficult life circumstances due to the war. In most regions, it is the out-of-school time that has taken on the responsibility of distracting children from the terrible everyday life of war. The educational potential of out-of-school education is considered by Ewa Kochanowska (Kochanowska, 2023).

It should be noted that the level of development of out-of-school education before the war was quite high. Thus, according to the results of the monitoring of the socio-economic development of regions in 2018 in the area of “Accessibility and quality of services in the field of education”, Sumy region took 6th place (Sumy, 2019). According to one of the indicators in this area, namely “The proportion of children covered by out-of-school education, as a percentage of the total number of school-age children” Sumy region took the 2nd place, as almost 65,550 pupils of the entire region studied in creative associations of out-of-school education, which is 94.8% of school-age children. To ensure the right of every child to identify and develop creative abilities, 83 out-of-school educational institutions operated in the region.

However, it is worth noting that, according to the Ministry of Education and Science (Network, 2023), over the past three years, the network of out-of-school education institutions in Ukraine has decreased by 10% – from 3916 in 2021 to 3501 as of January 1, 2023. This trend is due to several factors: in the process of

decentralization, out-of-school education institutions are being liquidated or reorganised (through mergers or acquisitions); rural territorial communities in most cases do not have the financial capacity to create.

In 2020, the number of out-of-school education institutions in Sumy region also decreased. According to the data (Public, 2020), 80 out-of-school education institutions provided out-of-school education in the region, including 54 out-of-school education institutions (centers, houses, palaces of children's and youth, scientific and technical creativity, aesthetic education, stations of young naturalists, tourists, military-patriotic clubs, art schools) and 26 children's and youth sports schools. In 3 023 clubs and 695 sports groups, 59 052 pupils received out-of-school education, which is 60% of the total number of students in educational institutions.

As of January 1, 2024, according to (Out-of-school, 2019; Out-of-school, 2024; Ukraine, 2024) in the Sumy region, out-of-school education services were provided by an extensive network of institutions. In terms of districts, the largest number of institutions operates in Shostka district – 15. In Romny district, 8 institutions provide out-of-school education, in Konotop district – 16, in Sumy district – 14, in Okhtyrka district – 11 and in Sumy city – 5 institutions.

Vocational education. Vocational education is aimed at training skilled workers and middle managers who can work in various sectors of the economy. It provides the acquisition of practical skills and knowledge necessary to perform professional duties at work, in institutions or organisations. The development of vocational education is of great importance for the region, as the availability of diverse professionals contributes to economic growth and social stability, which can be seen in many countries (Shrama et. al., 2024).

Vocational education provides basic vocational skills focused on a specific working profession. Graduates are usually qualified as workers or junior specialists and can start working after graduation. Given the fact that the country is at war and the Sumy region is constantly suffering from enemy attacks that destroy both industrial and social

infrastructure, there is a growing need for skilled workers in various fields such as industry, construction, agriculture, services, etc.

In 2023, 5.3 thousand people were enrolled for training, which is 11.5% more than in 2022. It should also be noted that almost 5 thousand students graduated this year (Press, 2024).

As can be seen from the graphs (Fig. 4.10), over the past 10 years, the number of vocational education institutions has decreased by 17.6% and the number of students in these institutions has decreased by 38.1%.

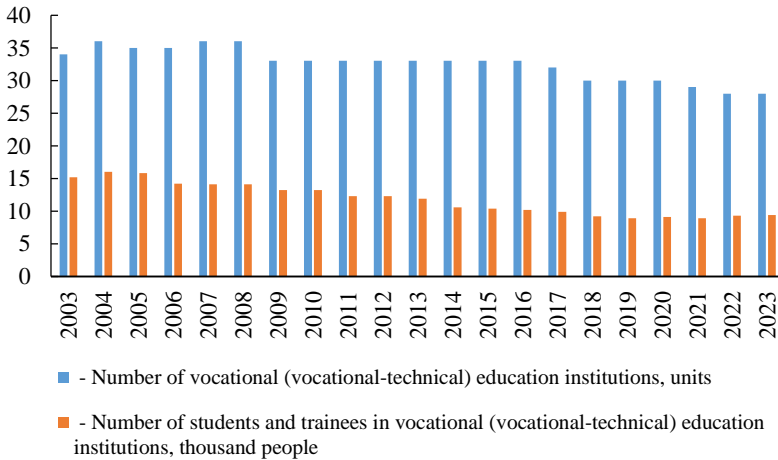


Fig. 4.10. The vocational (vocational-technical) education institutions in Sumy region

According to the Register of Educational Institutions (Register, 2024), vocational education was provided by 28 educational institutions located in different districts of the region and the regional center. Thus, in the city of Sumy, educational services were provided by 8 vocational schools, 3 institutions in Sumy district, 5 in Romny district, 3 in Konotop district, 2 in Okhtyrka district and 7 in Shostka district.

Vocational pre-university education provides training for middle-level professionals who occupy an intermediate position between workers and specialists with higher education. Graduates receive a junior specialist or professional bachelor's degree, which

allows them to work in more complex positions or continue their studies in higher education. At the beginning of the 2023/2024 academic year, there were 9 higher education institutions in Sumy region with almost 13 thousand students. It is also possible to obtain professional higher education in 13 separate structural subdivisions of higher education institutions (Table 4.1). In 2023, 5.3 thousand people were enrolled (Press, 2024).

Table 4.1. Institutions of professional higher education
(Institutions, 2024)

	Number of Institutions of professional higher education, units	Number of people in the Institutions of professional higher education, thousand	Number of people enrolled in Institutions of professional higher education, thousand	Number of persons released from Institutions of professional higher education*, thousand
2020/21	8	9.0	2.9	2.5
2021/22	9	10.9	3.9	2.9
2022/23	9	11.3	4.2	3.1
2023/24	9	12.8	5.3	3.1

* At the end of 2020, 2021, 2022, 2023.

As shown in the table 4.1, the number of students in professional higher education institutions is gradually increasing. This can be explained by many factors, including the fact that this education is focused on training mid-level professionals with practical skills that are immediately in demand in the labor market. This makes education attractive to those who want to start a career quickly without spending many years obtaining a higher education. In addition, vocational higher education institutions often offer more affordable study conditions than universities, including lower tuition fees. In addition, the labor market is always in high demand for mid-level specialists in various fields, such as technical specialties, medicine, agriculture, services, etc. Another “bonus” is that

graduates have the opportunity to continue their studies in higher education institutions with a reduced period of study. This makes vocational pre-university education attractive for those who want to first obtain a specialty and then pursue higher education.

In terms of administrative units, the largest number of higher education institutions is registered in Sumy – 4 independent institutions and 3 separate structural subdivisions – Sumy State University, National University of Food Technologies, Sumy National Agrarian University. In Sumy district, professional higher education is provided by 2 municipal institutions and 1 separate structural subdivision of Sumy National Agrarian University. Konotop district is represented by 2 municipal institutions, 2 separate structural subdivisions of Sumy State University and 1 separate structural subdivision of Sumy National Agrarian University. In Shostka district, professional higher education is provided by 2 municipal institutions and 3 separate structural subdivisions – Sumy State University, Hlukhiv Oleksandr Dovzhenko National Pedagogical University and Sumy National Agrarian University. In Okhtyrka district, professional higher education can be obtained at a separate structural subdivision of Sumy National Agrarian University. Romny district provides educational services for professional higher education in separate structural subdivisions of the Kyiv National Economic University named after Vadym Hetman and Sumy National Agrarian University.

Higher education in Sumy region. At the beginning of the 2023/2024 academic year, 23 thousand students were enrolled in 6 higher education institutions in Sumy region. 9.3 thousand people were admitted to study and more than half of them started their studies for the first time (Table 4.2). In 2023, 3.6 thousand people graduated. As of the beginning of 2024, 1532 postgraduate students were studying at the appropriate level in 5 scientific institutions of the region (Press, 2024).

As can be seen from the table 4.2, the number of students pursuing higher education has increased in recent years. There are many reasons for this, such as the fact that higher education in Ukraine is increasingly perceived as a necessary element for a successful career and social status. Many professions in the labor

market require a university degree. In some professions, higher education provides access to higher earnings and social guarantees, which is a significant incentive for many young people. Opportunities for admission to higher education institutions have been expanded, in particular by increasing the number of educational programs and introducing distance and part-time study. In addition, many universities offer flexible forms of tuition fees or benefits for certain categories of students. In today's competitive labor market, higher education is seen as a way to gain additional knowledge, skills and qualifications that can increase the chances of successful employment and career growth. The demographic situation is also worth mentioning, as the generation born in the early 2000s has reached the age of university admission and this generation is numerically larger than previous ones. This also affects the growth in the number of students. Thus, the growth in the number of students pursuing higher education is the result of both socio-economic and educational changes that have taken place in Ukraine in recent years.

Table 4.2. The higher education institutions

	Number of higher education institutions, units	Number of people in higher education institutions, thousand	Number of people admitted to higher education institutions, thousand	Number of people who graduated from higher education institutions*, thousand
2020/21	7	18.9	4.7	8.4
2021/22	6	18.1	3,8	4.3
2022/23	6	19.2	4.9	5.4
2023/24	6	23.0	5.0	3.6

* At the end of 2020, 2021, 2022, 2023.

As indicated in the Register of Educational Institutions (Register, 2024), higher education institutions are mainly concentrated in Sumy. These include Sumy State Pedagogical University named after A. S. Makarenko, Sumy State University and Sumy National Agrarian University. Higher education is also provided by Sumy Regional Institute of Postgraduate Pedagogical Education, Sumy Branch of National University of Food

Technologies and Sumy Branch of Kharkiv National University of Internal Affairs. In Hlukhiv, there is Hlukhiv National Pedagogical University named after Oleksandr Dovzhenko. Higher education can also be obtained at Shostka and Konotop Institutes of Sumy State University.

Thus, education plays a crucial role in raising the intellectual and cultural level of the population, which contributes to the cultural and socio-economic development of the regions. Accessibility of educational services is an important condition for this process. The hostilities in Sumy region have hurt education. First of all, educational institutions, especially those located near the border, have suffered from the hostilities. This negatively affected the educational infrastructure and accessibility of educational services. As of April 2023, a significant number of institutions needed to be restored. Declining birth rates and hostilities have led to a reduction in the number of preschools, which exacerbates the problem of organising preschool services, especially in rural areas. In many village communities, the number of institutions is insufficient, creating problems with access to preschool education.

Out-of-school education is an important element in the development of children and youth, ensuring the comprehensive development of their interests, abilities and talents. It is aimed at the harmonious development of the individual, helps to form social skills, civic awareness and helps to identify professional interests. Despite the high level of development of extracurricular education before the war, current conditions require a rethinking of its role. During the war, out-of-school education plays a particularly important role in supporting children in difficult life circumstances. However, in recent years, the network of out-of-school education institutions has shrunk, which is a cause for concern and requires additional attention from the state and local communities to ensure the availability and quality of such services.

General secondary education institutions in Sumy region provide basic education for children, but in recent years there has been a downward trend in the number of such institutions and students. This decline has become even more pronounced due to the forced migration of the population during the war. The indices of

territorial concentration and social density show an uneven distribution of educational institutions in different communities of the region, which affects the accessibility of education for children in remote areas. Particularly low accessibility rates are observed in rural communities, where the number of institutions is insufficient to meet the needs of the local population. This emphasises the need for further development of the network of general secondary education institutions, taking into account territorial features to ensure equal access to quality education for all children in the region.

Vocational education is key to training skilled workers and mid-level professionals who are essential for the development of the region's economy. Given the challenges faced by Sumy region due to the war, there is a growing need for such specialists, especially in the industrial, construction, agricultural and service sectors. Despite the decline in the number of institutions and students in recent years, vocational education continues to play an important role in providing the region with the necessary personnel. In 2023, the number of students enrolled in vocational education increased, indicating an increased demand for such education under martial law.

Professional higher education institutions are also gaining popularity, as evidenced by the gradual increase in the number of students. These institutions provide training for mid-level professionals whose practical skills are in demand in the labor market. The attractiveness of this education is enhanced by the affordability of the learning environment and the possibility of further education in higher education institutions. Thus, both vocational and professional higher education play an important role in training personnel that contribute to the recovery and development of the region's economy.

Sumy region is experiencing an increase in the number of students pursuing higher education due to several socio-economic and educational factors. The demand for higher education is growing due to the requirements of the labor market, where a university degree is often a prerequisite for successful employment and career growth. Expanding enrollment opportunities, the introduction of distance and part-time learning and flexible forms of tuition fees make higher education more accessible. The demographic situation

is also having an impact, as the generation born in the early 2000s is actively enrolling in universities. Higher education institutions are mainly concentrated in Sumy, making the city the key educational center of the region.

In general, the need to restore and develop educational services in the context of war is critical to ensure the availability of social services and further socio-economic development of the region.

4.2 Cultural services for the population of Sumy region

The current trends in the development of territorial communities, which began to take shape at the end of 2020 as part of the reform of the territorial organisation of power and local self-government in Ukraine, have exacerbated the issue of forming the provision of services to the population by cultural institutions and the organisation of geocultural space in general. This is because today, along with increasing requirements for the quality and accessibility of socio-cultural services to residents of the territorial community, the importance of their content is growing. Along with measures to implement a coherent national cultural policy, it is also important to preserve and popularise local distinctive culture. These tasks can be achieved by preserving and developing a network of cultural institutions that form the supporting framework for the socio-cultural development of the territorial community and the residents of the region as a whole (Zadvornyi, 2020).

The basic network of cultural institutions consists of two levels – national and local. This study of the sociocultural sphere of Sumy region covers local level institutions. The main requirements for the formation of cultural institutions by executive authorities and local self-government bodies are defined by the Procedure for the Formation of the Basic Network of Cultural Institutions, approved by the Resolution of the Cabinet of Ministers of Ukraine of October 24, 2012, No. 984 (as amended by the Resolution of the Cabinet of Ministers of Ukraine of September 15, 2021, No. 970 and of December 01, 2023, No. 1261) (On Approval, 2021). According to

this Procedure, the basic network of the local level includes municipal cultural institutions (libraries, museums, galleries, reserves, exhibition halls, theaters, philharmonic societies, concert organisations, artistic groups, cinemas, film and video distribution enterprises, associations, palaces and houses of culture, other clubs, studios centers of folk art, centers of folk culture, cultural service centers, parks of culture and recreation, etc.), cultural educational institutions (art schools, art lyceums, professional art colleges, higher art education institutions), the lists of which are approved by local executive authorities and local self-government bodies.

As indicated in the monograph (Geography, 2021), before the war in 2020, the socio-cultural services of the region were represented by 1179 cultural institutions, including: 591 club institutions, 530 libraries, 36 art schools, 13 state museums, 37 public museums, a national reserve and 2 state historical and cultural reserves, 2 theatres, a philharmonic, a regional scientific and methodological center for culture and arts and the D.S. Bortnyansky Professional College of Arts and Culture. The cultural institutions employed 4605 people. Between 1980 and 2020, the number of cultural institutions decreased. In particular, during this period, the number of libraries decreased by 39.5% and the number of clubs decreased by 56.8%. Over the past 10 years, the rate of decline has slowed. Thus, the number of libraries decreased by 5.2% and the number of clubs by 6.8%.

The processes of decentralisation and the formation of territorial communities have influenced the development of cultural services. Today, communities have virtually completed the formation of basic networks of cultural institutions, primarily in the form of a core cultural or artistic institution (house of culture, center of culture and art, public library, etc.) and its branches operating in the community's settlements. The main focus is on supporting the institutions of the core network; theoretically, the main goal of this process is to ensure effective and comprehensive cultural and artistic development of settlements. However, the specifics and realities of the war, the shortcomings of the post-reform decentralisation period and the rapid depopulation characteristic of Sumy region are increasingly highlighting the need to optimise such networks. In this

context, to ensure the optimal development of cultural services for the population of communities, it is extremely important to study this issue from a socio-geographical perspective.

Elements of the functioning of the basic network of cultural institutions are closely linked to the development of strategic community development plans, socio-economic development programs and sectoral programs in the field of culture and art. Today, different communities are working on optimal models for ensuring the sustainable functioning of the basic network of cultural institutions. Particular diversity in this area can be observed in urban communities, especially those formed based on city councils of former cities of oblast subordination and the oblast center and including suburban settlements.

According to the current administrative-territorial structure, Sumy region is divided into 5 districts covering 51 territorial communities. The latter, in turn, are divided into starostynskyi districts, the number of which practically corresponds to the pre-reform composition of village councils that participated in the voluntary amalgamation. Lebedyn, Krolevets and Shostka city territorial communities are the largest in terms of area (over 1200 km²), with boundaries that coincide with the former districts of the same name that existed before the 2020 administrative reform. Communities formed around other cities of region subordination are much smaller in area (Okhtyrka city community is the smallest in general and also consists of three separate enclaves). At the same time, most of the region's population is concentrated here (25.58% of Sumy Oblast inhabitants live in the community, while its share in the region's area is only 1.51%). Konotop community has 8.68% and Okhtyrka community has 4.56% of the population of Sumy region, while they account for 0.44% and 0.36% of the total area of the region.

As of the beginning of 2022, the basic network of local cultural institutions of the territorial communities of Sumy region consisted of 1106 units in communal ownership (Table 4.3).

Table 4.3. Cultural institutions of the basic network at the local level in Sumy region

Administrative district	Number of cultural institutions in the core network
Konotop	230
Okhtyrka	148
Romny	224
Sumy	293
Shostka	211
<i>Total</i>	<i>1106</i>

To characterise the component structure of the sphere of culture and art of communities, we have identified the following types of institutions: houses (centers) of culture, clubs (including branches), leisure facilities (points), libraries (including branch libraries), music (art) schools, museums (Fig. 4.11).

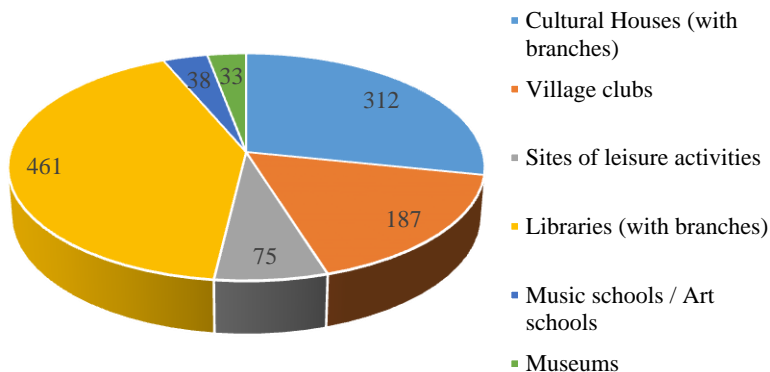


Fig. 4.11. The structure of the basic network of cultural institutions in Sumy region by their type (units) as of January 1, 2022

The most common component of the network of cultural services for the population in Sumy region is club-type institutions: palaces (houses, centers) of culture (leisure) and clubs. In total, there

are 499 of them (including branches), which is 45.1% of the total number of institutions in the basic network. The main purpose of these institutions is to promote the development of amateur creativity, organise cultural events, educate children and youth, provide meaningful leisure activities, organise cultural and educational events of a spiritual and patriotic nature and hold various festivals and concerts. It should be noted that these institutions have more than 300 clubs: 236 of them have the title of “folk” and “exemplary” (Annex A). Every year they organise several hundred cultural events on a wide range of topics (Table 4.4).

Table 4.4. Typological structure of the basic network of cultural institutions of administrative districts of Sumy region
(as of January 1, 2022)

Administrative district	Houses of culture (with branches)	Rural clubs of club type	Leisure facilities	Libraries (with branches)	Music schools / art schools	Museums
Konotopsky	63	35	7	108	6	11
Okhtyrka	53	35	2	51	4	3
Romny	58	45	19	91	7	4
Sumy	89	36	25	122	13	8
Shostka	49	36	22	89	8	7
<i>Total</i>	312	187	75	461	38	33

Library institutions are the second largest in the system of the basic network of cultural institutions, with a share of 41.7%. Due to decentralisation and the creation of territorial communities, the geography of library services in the region has undergone dramatic changes. The network of public libraries in the communities is organised taking into account the Minimum Social Standards for the provision of public libraries in Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine of 30.05.1997 No. 510. The standards for library services are as follows (Kornus, 2012): in settlements with up to 500 inhabitants, by decision of the relevant local self-government body, library services are provided by a public

library or through non-stationary forms of service (library point, mobile library). In settlements with a population of 500 to 3 thousand people, there should be at least one public library on the territory of the village (rural) council; in settlements with a population of more than 3 thousand people, there should be one library per 3-5 thousand people.

The number of city libraries is determined by the population density and the number of storeys of buildings:

1. In residential areas with multi-storey buildings (8 or more floors), one library per 15-20 thousand people;

2. In residential areas with low-rise buildings (1-3 floors) – one library per 5-8 thousand people. To serve children and youth in cities with a population of up to 75 thousand inhabitants, there should be at least one library for children for 8-12 schools, in cities with a district division, one library for children in each administrative district. In the regional center, there is a regional library for children as a research, information and advisory center on the cultural development of children.

3. In the regional center, there is a regional universal scientific library, which is the main institution in the field of library and information services for the population, a research, methodological, coordination center for libraries of all systems and departments of the region, a central regional book depository, a regional depository of local history literature, a center for book exchange and interlibrary loan (Kornus, 2012).

Public libraries have been established in almost all community centers in the region as municipal institutions and centralised library systems have been established in district centers. In addition to providing traditional services to readers, libraries are becoming more than just a book collection. In many cases, they are multifunctional modern open centers and sometimes even entire information and resource platforms with book, newspaper and magazine collections, meeting rooms, cafes and children's rooms, such as the Trostianets Public Library, which has become a modern multimedia, educational, cultural and information space. Such institutions are more attractive to users.

Of course, the number of libraries alone cannot give a

complete picture of the level of library services in the district and the region as a whole. This level depends not only on the development of the network of libraries and their territorial features, the availability of book collections and their correlation with the population. Meeting the needs of readers also depends on the concentration of books in libraries and their diversity. These institutions should contain literature of different genres to meet the needs of different segments of the population. Libraries with a book collection of more than 10 thousand copies usually have more diverse literature. In city libraries, the library collection is almost equal to that in village libraries, although the number of libraries in rural areas is higher than in cities.

Leisure institutions perform similar functions to clubs and sometimes they also have a library that is not part of the community library network.

Primary art education is represented by 38 music (art) schools (including branches). The largest number of them is in Sumy district, where such schools operate in Bilopillia, Vorozhba, Krasnopillia, Lebedyn, Mykolaivka rural, Sad, Stepanivska and Sumy (5 schools) communities. The main purpose of this type of institution is to develop children's creative abilities and talents, to teach them practical skills, to acquire knowledge of national and world culture and art and to acquire special artistic performance competencies.

A significant addition to the basic network of community cultural institutions are national and regional cultural institutions engaged in similar or related activities. Here, first of all, it is worth noting the Hlukhiv National Reserve. The same category includes regional institutions that are in the communal ownership of the Sumy Regional Council. They are represented by 2 academic theaters: Sumy Regional Academic Theater for Children and Youth, Sumy National Shepkin Theater (granting the latter national status in 2020 did not change the registration of the theater as a municipal institution of the Sumy Regional Council), 2 libraries (universal scientific and children's), 3 museums (Sumy Regional Museum of Local Lore, Sumy Regional Art Museum named after N. Onatskyi. Onatsky, the A.P. Chekhov Memorial House-Museum in Sumy), the Philharmonic, the Sumy Regional Scientific and Methodological

Center for Culture and Arts and the Sumy Professional College of Arts and Culture named after D.S. Bortnyansky. The above institutions, on the one hand, create competition for municipal institutions within the framework of commercial activities and on the other hand, reduce the burden on the basic network of territorial communities.

The functioning of cultural institutions and the implementation of measures to implement a consistent cultural policy are ensured by the existence of specialised structural units of management and administration in the system of executive committees of territorial communities – departments of culture, which often combine administration in related fields – education, tourism, sports, youth policy, etc. Currently, the organisational and managerial mechanism of the network of institutions meets the requirements for fulfilling functional tasks and innovative development of the sector.

The territorial organisation of cultural institutions at the local level of communities in Sumy region is an orderly network that is directly dependent on the population of the settlement and its administrative status. In general, according to the results of the socio-geographical analysis, we can distinguish 4 hierarchical levels of cultural and artistic systems: regional, district, basic (community) and primary (starosta). These systems correspond to the classical approach to their allocation, which is common in social and cultural geography (Zadvornyi, 2016).

Based on the above, we have identified one regional cultural and artistic center. It is formed based on the administrative center of the community and the region – the city of Sumy, which is characterised by a pronounced functional core. It has been assigned the highest rank, given the presence of all types of institutions here, the location of municipal cultural institutions at the regional level and the management bodies of the sector. The institutions of the basic cultural service network of the Sumy city community, such as the Sumy Municipal Gallery, are also visited by residents of other communities.

The next hierarchical level is the district level. All districts' centers today are also centers of territorial communities, but they have a greater number of cultural institutions than just city

communities. In particular, there is a local history museum and sometimes several municipal museum-type institutions, a centralised library system, etc.

In the rural areas of the region, 640 institutions (57.9%) of the basic network of cultural services are concentrated. Accordingly, they form 2 levels of cultural and artistic systems: basic (community) and primary (starosta). The centers of the latter are the administrative centers of starosta districts, where a branch of a house of culture (club) and a branch library are usually located.

The geographical specificity of the location of elements of the basic network is reflected in the indicators of the provision of administrative-territorial units of the region with cultural and art institutions (Table 4.5).

Table 4.5. Provision of cultural institutions to the basic network of territorial communities by administrative districts of Sumy region

Administrative district	Number of institutions per 10 km ² of area	Number of institutions per 100 inhabitants
Konotop	0.44	1.14
Okhtyrka	0.48	1.22
Romny	0.48	1.17
Sumy	0.56	0.34
Shostka	0.42	1.26
<i>By region</i>	0.48	1.06

The number of institutions per 10 km² of area is highest in Romny – 0.68 institutions per 10 km² and Sumy – 0.56 institutions per 10 km². In other districts, it is lower than 0.5 institutions per 10 km² and in the region as a whole it is 0.48 institutions per 10 km². In terms of territorial communities, the highest density of cultural institutions of the basic network – more than 1 per 10 km² – is concentrated in Konotop city, Okhtyrka city and Stepanivka rural communities: 1.39, 1.34 and 1.08 institutions per 10 km², respectively. It is most sparse in Bochechky village, Berezivka village, Buryn’ city communities – 0.28 per 10 km² each and Boromlya village community – 0.26 institutions per 10 km².

In terms of the number of institutions per 1000 inhabitants, Znob-Novhorodske rural community stands out, while Khmelivka

village, Vilshany village, Esman rural andriyashivka village, Myropillia village, Dubovyazivka rural and Synivka village communities have a high number of cultural service institutions per 1000 inhabitants – more than 3 institutions per 1000 inhabitants. This list includes 4 communities from the Romny district, where the provision of the population with cultural institutions is the highest – 2.08 institutions per 1000 people.

Sumy district, which is distinguished by its population size, was expected to be among the least well-supplied in this regard, with 0.34 basic cultural institutions per 1000 people. The same can be said for other communities with a large number of residents: Okhtyrka, Konotop and Sumy city (0.23, 0.16 and 0.09 institutions per 1000 people, respectively) (Fig. 4.12).

For a detailed study of the coverage of the territory of the amalgamated communities by cultural institutions, we calculated the coefficients of their territorial concentration by calculating the corresponding index. A value of I_{tc} less than 1.0 indicates a low concentration of the studied indicator in a particular community; if the value is close to 1.0, we can talk about the location of cultural service institutions at the average regional level; above 1.0 – about a high saturation of such institutions compared to this indicator.

As we can see, as a result of decentralisation, the cultural and artistic sphere of Sumy region has become territorially disproportionate. Various factors contributed to this, for example, when a community operates within the territorial boundaries of one former administrative district (one district then – one community today), or when a “united” community was formed by settlements of only two former councils. This resulted in communities that differ significantly in size. For example, the area of the largest community, Lebedyn city and the smallest Okhtyrka city, differ by more than 20 times. At the same time, the former includes 125 settlements and the latter – 11. Understandably, such small communities will have high values of the I_{tc} , as in this example for Lebedyn and Okhtyrka communities – 0.70 and 2.78, respectively.

In general, the highest values of the I_{tc} are typical for the communities of Romny district and the lowest – for Shostka district.

Given the peculiarities of service provision by cultural

institutions, it is more important to determine whether the location of cultural institutions corresponds to the peculiarities of population settlement. This can be done with the help of the index of localization of cultural and artistic institutions in amalgamated communities.

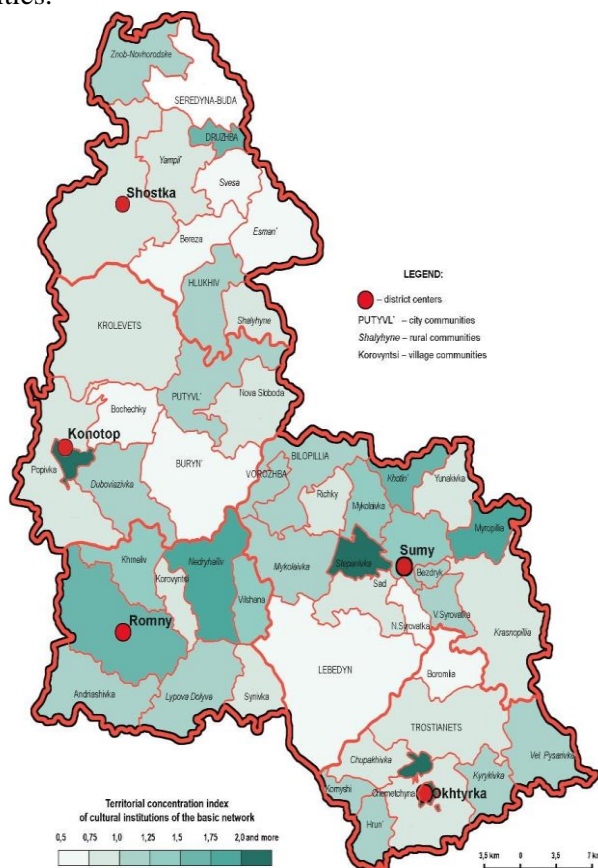


Fig. 4.12. Territorial concentration of institutions of the basic network of culture and art maintained by local communities of Sumy region (as of 01.01.2022)

Having analysed the geographical features of the territorial localization of cultural and artistic institutions (Fig. 4.13) maintained by local communities, we found high and extremely high indicators

in rural and village communities.

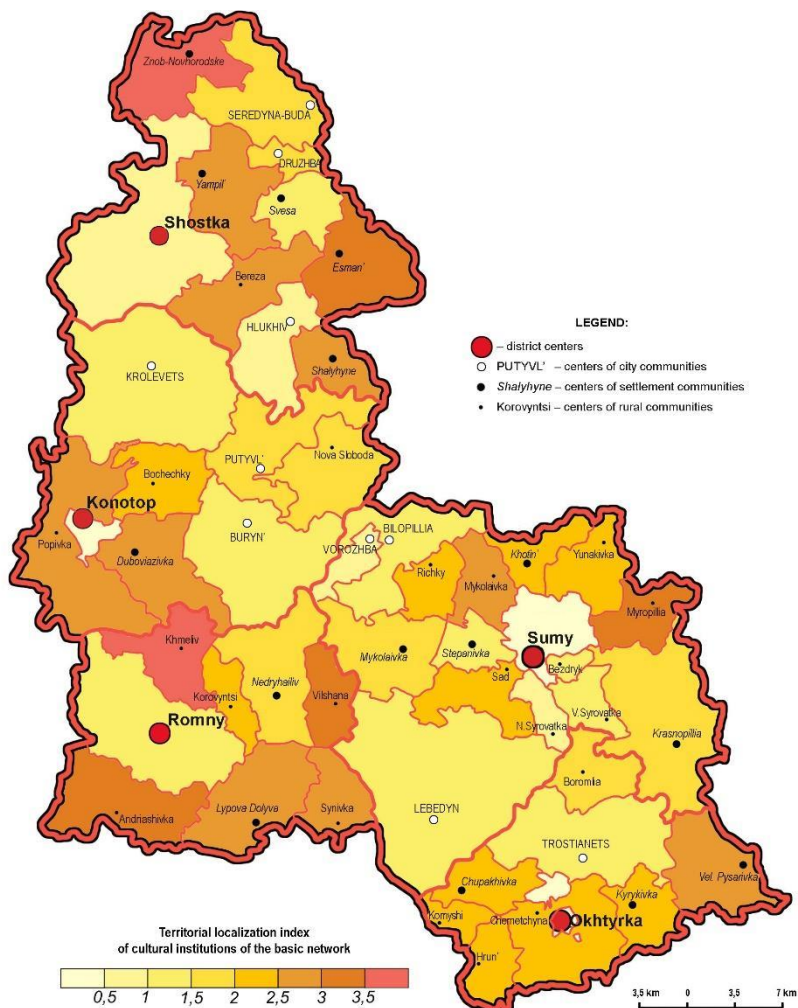


Fig. 4.13. Territorial localization of the institutions of the basic network of culture and art maintained by local communities of Sumy region (as of 01.01.2022)

Thus, in the Myropillia andriyashivka, Vilshana village and Esman' rural communities, the value of I_l exceeds 3.0 and in the

Znob-Novgorodske rural community it reaches 5.23. This will further lead to a forced optimization of the basic network of cultural institutions in the respective communities. It will be much easier to maintain cultural institutions in urban amalgamated communities, where the concentration and localization of cultural service institutions are lower (in Sumy, Konotop, Okhtyrka and Shostka urban communities, the values of I_l are 0.08, 0.15, 0.22 and 0.59, respectively) and there are greater opportunities for their development.

Based on the socio-geographical specifics of cultural services for the population of Sumy region, the existing network of cultural institutions generally provides the inhabitants' needs for cultural services, given the financial capabilities of territorial communities and the functioning of the entire cultural service system in the context of war. However, even outside of martial law, some problems could significantly improve the provision of cultural services. The key ones are as follows:

- outdated material and technical base: musical instruments, stage costumes, scenery, music literature, technical means, library collections, equipment;
- outflow of highly skilled creative professionals due to a decrease in the prestige of the profession;
- depopulation, which makes it unprofitable to maintain municipal cultural and artistic institutions in sparsely populated settlements;
- conservatism in the forms and methods of providing cultural services, insufficient implementation of creative and cultural industries.

At the same time, despite the above problems, the employees of the institutions show decent performance and respond flexibly to modern challenges. An important feature of the network of cultural institutions of territorial communities in Sumy region is the real prospects for its expansion and improvement. These include the following measures:

- opening of cultural institutions, primarily in cities, which can be done through the renovation of premises and buildings in their industrial zones;

– taking public museums and other cultural institutions into communal ownership and implementing creative initiatives;

Increasing various forms of cultural mobility and touring activities; cultural exchange between villages and cities through various art projects.

At the same time, the issue of the ability of territorial communities to maintain an extensive basic network of primary cultural institutions, which are low-profit and subsidised, remains quite relevant. Lack of funding and progressive depopulation will lead to their optimization, especially in those communities that have inherited a large number of cultural institutions in villages that are gradually becoming sparsely populated.

Summing up, we can say that the socio-geographical study of the basic network of local cultural institutions in the territorial communities of Sumy region revealed the following: the formation of a modern network within the framework of the decentralisation reform is generally complete; unique geospatial features of the network of cultural institutions are caused by the configuration of the territory or other community and the peculiarities of the settlement network; the component structure is formed by institutions of six types; the territorial and functional structure of the network is represented by four types of the findings of the study can be used in the creation and implementation of targeted programs for the development of culture and art to improve the territorial accessibility of service provision.

Thus, social infrastructure is the basis for the development of such industries as healthcare, education, culture, transportation, etc. It is an important factor for the economic development of the region, influencing investment attraction, entrepreneurship development and labor productivity, as it creates favourable conditions for the population to live and work. In general, it creates favourable conditions for the comprehensive development of the region and the improvement of its competitiveness at the national level. As noted above, Sumy region has certain problems in the development of social infrastructure. These materials can serve as a basis for developing a social development strategy for the region or as a material for developing programs for the socio-economic

development of territorial communities, districts, or the region as a whole. After all, the level of social infrastructure development is an indicator of the region's well-being, which has a long-term impact on the quality of life, economic development and social stability.

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5. SOCIO-GEOGRAPHIC FEATURES OF THE DEVELOPMENT OF THE TRANSPORT AND MEDICAL INFRASTRUCTURE OF SUMY REGION

5.1 Scientific and methodological approaches to the analysis of social infrastructure

The level of development of social infrastructure has an important impact on the population's quality of life. A developed social infrastructure, including access to medical, educational, cultural and other social services, directly affects the comfort and well-being of the region's residents. It provides access to quality education, timely medical care and access to cultural and social events. A well-developed social infrastructure contributes to social stability by meeting the basic needs of the population and reducing social tensions. This, in turn, reduces the risk of conflict and increases public safety. In addition, a developed social infrastructure increases the attractiveness of the region for migrants and new residents, contributing to the inflow of labour and the development of the local economy. It also counteracts the outflow of population from the region.

As noted in the article by M. Bil (Bil, 2023) social infrastructure includes objects of social and household (housing and communal services and improvement, trade, catering, communications, transport, consumer services) and socio-cultural (education, medicine, sports, culture, religion, environmental protection, recreation) purposes.

Vitrenko (1993) in his monograph proposes to divide social infrastructure into 2 groups:

Group 1 – social and household infrastructure (housing and communal services; consumer services; trade and catering; passenger transport; communications);

Group 2 – social and cultural infrastructure (education; culture and art; healthcare, physical culture and sports; social security).

According to O. Shabliy et al, (Shabliy 2000) and others, the concept of 'social infrastructure' is applied to the entire set of services that meet the personal (physiological, material, spiritual) needs of the population. They divide all elements of infrastructure into three groups:

a) social infrastructure (which includes all types of service enterprises);

b) production infrastructure (the system of material and technical supply and distribution with its bases and warehouses, industrial transport and some other types of communications, etc.), i.e. production services;

c) general technical base that simultaneously serves both previous groups: roads, power supply systems, water supply, etc.

In our opinion (Kornus, 2009), the social infrastructure includes housing and communal services; trade and catering; consumer services; passenger transport; communication services; educational, cultural and artistic institutions; medical and sanatorium and resort services; physical culture and sports; tourism and recreation; ensuring public safety and law and order; lending and state insurance; social security; management system and public organisations.

The development of social infrastructure depends on the socio-economic characteristics of the regions, it occurs by changes in production and significantly affects the efficiency of enterprises through the participation of production and social services in the formation of consumer value and product price.

In the article by D. Malchykova et al (Malchykova, 2016) describes infrastructure as a scientific concept, identifies types of infrastructure: economic infrastructure (economic infrastructure); social; transport; market (banks, insurance companies, exchanges, fairs, consulting and information and marketing firms, etc.); innovation; military; environmental and ecological. According to the authors, there is currently no generally accepted methodology for analysing the infrastructure of regions and cities. To determine the level of infrastructure in a region, they propose to analyse trends in the development of its components:

1) transport subsystem;

- 2) communication subsystem;
- 3) environmental subsystem;
- 4) recreational subsystem;
- 5) housing and communal services subsystem;
- 6) educational subsystem;
- 7) medical subsystem;
- 8) social security subsystem;
- 9) cultural subsystem.

Y. Shpylova (Shpylova, 2006) emphasises that when assessing the level of development of social infrastructure, it is necessary to use the normalised and normalised-integral indicators of individual branches of social infrastructure. This makes it possible to calculate the normalised integral coefficient of social infrastructure development based on heterogeneous indicators.

In the monograph by O. Kornus et al (Kornus, 2009) considers methodological approaches to studying the integral level of development of the service sector in the district (or region as a whole), offers simple indicators of various subsystems of the service sector (for example, provision of library institutions (per 1000 people); density of roads, km/km²; provision of the population with medical personnel, hospitals per 1000 people, etc.), which are summed up to calculate the integral indicator and compare it with the baseline:

$$P_i = \frac{\sum_i^m O_i^m}{n} \quad (5.1)$$

where P_i is the integral level of development of the service sector in the district; m – is the provision of the population of the I district with the specified service; n – is the number of simple indicators characterising the service m .

The base level can be considered a normative, average (region-wide) or benchmark indicator.

Due to such a large number of simple indicators, the integral indicator of service level can conceal the underdevelopment of

certain service industries, as pseudo-compensation may occur due to high levels of development in other industries. Therefore, when calculating the integral level, indices from 0 to 100% (or from 0 to 1) are summed up. In other words, for each industry, an upper limit value is introduced that is equal to the baseline (or, in a simpler version, the maximum value of the indicator for that type of activity). To ensure that the information obtained is not completely lost, an auxiliary coefficient of improved service is used. It is equal to the share of improved indicators in the total number of indicators. The integral level of service development is calculated for administrative and rayon communities, etc. for those administrative-territorial units where statistical reporting is available. This formula can be modified to study the level of social infrastructure development by selecting the necessary indicators.

According to S. Tulchynska and S. Kyrychenko (Tulchynska, 2017), it is appropriate to use the following statistical indicators to assess the development of social infrastructure: coefficient of variation, variance, standard deviation, as well as methods of grouping, standardisation of indicators, determination of total and integral indicators, etc.

Most methodological approaches to assessing the development of regional social infrastructure are based on the use of tools for determining an integral assessment based on various indicators, which are grouped into certain subgroups that characterise multidimensional processes of social infrastructure. The integral indicator is calculated either by using weighting coefficients, taking into account the opinion of experts, or by determining the deviation of the normalised values of the partial indicators from the reference value, which is most often taken as the maximum value of the partial indicator in a particular region. After assessing the state of development of social infrastructure in the regions, to develop further development options, taking into account regional specifics and the impact of external factors, making managerial decisions and measures to revive the development of social infrastructure, a special place is occupied by the use of economic and mathematical modelling methods, which minimise labour and time costs in processing the parameters of social infrastructure development by

grouping regions, depending on the value of the social infrastructure development index obtained. As noted in the scientific work of the above-mentioned authors, the common features of the studied methods of assessing the development of social infrastructure are that they are based on the allocation of groups of partial indicators that characterise the system as a whole, the calculation of an integral indicator of social infrastructure development, ranking of regions by rating depending on the results obtained, which helps in the development of a development strategy, based on the formulated forecasts and the identification of measures to ensure their implementation.

To study the level of development of social infrastructure in Sumy region, we took transport services, education, healthcare and culture.

5.2 Development of transport infrastructure in the territorial communities of Sumy region

Transport services are the basis for the development of the region's social infrastructure, as they provide a link between its elements, increase the accessibility of services and improve the quality of life. An efficient transport system promotes economic development, social integration and equal access to opportunities for all residents of the region. Developed transport infrastructure increases the investment attractiveness of the region by providing easy access to markets, resources and labour. This helps to attract investment, create new jobs and economic growth, determine the transport accessibility of settlements and form the spatial connectivity of the territory, determining the degree of socio-economic development of the region.

The Sumy region has a developed transport system represented by rail, road and urban electric transport. Transport services and their accessibility for the population are determined by the geographical features of the settlement network in the region. Urban settlements are centres of transport services of various categories and transport communications are its axes.

Transport axes of several orders can be distinguished. The first- to third-order axes are railways and motorways of national importance: international, national, regional and territorial.

The first-order transport axes in the region are the international transport motorway corridor (M02) Kipti – Hlukhiv – Bachivsk; the national road Kyiv – Sumy – Yunakivka (H02); the Konotop – Zernove railway (international railway corridor).

Railways are the 2-nd order transport axes in the region: Konotop – Vorozhba – Sumy – Spitsyn (Kharkiv), Bakhmach-Passenger – Rohynets – Andriyashivka – Lokhvytsia; the national road Sumy-Poltava (H12), as well as regional roads Hlukhiv-Putivl-Sumy (P44), Sumy-Krasnopillia-Bohodukhiv (P45), Krolevets-Pyriatyn (P60), Baturyn-Konotop-Sumy (P61) and the checkpoints Mykolaivka-Semenivka-Shostka-Hlukhiv-Katerynivka (P65). Before the war, there were 4 railway crossing points (Volfino, Pushkarne, Khutir Mykhailivskiy, Zernove) and 5 road crossing points (Bachivsk, Katerynivka, Ryzhivka, Yunakivka, Velyka Pysarivka) along the 498 km long state border.

Table 5.1. Roads of national importance in Sumy region

Zip code and road number	Route within the region, intersection with other roads	Length within the region, km
International highways		
E101 E381 E391 M02	Chernihiv region – Krolevets R60 – T 1907 – T 2503 – Bereza R65 – T 1915 – Bachivsk checkpoint	98 km
National highways		
H07	Chernihiv region – Romny R60 – T 1913 – T 1916 – Nedryhailiv T 1904 – Kushniry T 1926 – Shtepivka T 1906 – T 1926 – Sumy H12 – R44 – R45 – R61 – T 1901 – T 1909 – Yunakivka checkpoint	171 km
H12	Sumy H07 – R44 – R45 – R61 – T 1901 – T 1909 – Bypass Sumy – Trostianets T 1913 – T 1923 – T 1932 – Okhtyrka R46 – T 1705 – Lutyshche T 1928 – Poltava region	108 km
Regional highways		
P44	Hlukhiv R65 – Putivl T 1911 – T 1920 – T 1921 – T 1922 – Chumakove T 1910 – Bilopillia T	131 km

	1904 – T 1906 – Sumy H07 – H12 – R45 – R61 – T 1901 – T 1909	
P45	Sumy H07 – H12 – P44 – P61 – T 1901 – T 1909 – Krasnopillia T 1901 – T 1918 – Mezenivka T 1913 – Druzhba T 1923 – Velyka Pysarivka T 1705 – T 1931 – Kharkiv region	105 km
P46	Okhtyrka H12 – T 1929 – T 1705 – Kharkiv region	22 km
P60	Krolevets M02 – T 1907 – T 2503 – Mutyn T 1911 – Konotop R61 – T 1910 – T 1925 – Khmeliv T 1914 – Romny H07 – T 1913 – T 1916 – Poltava region	157 km
P61	Chernihiv region – Konotop P60 – T 1910 – T 1925 – Chernecha Sloboda T 1914 – Terny T 1904 – T 1919 – Sosnivka T 1906 – Sumy H07 – H12 – P44 – P45 – T 1901 – T 1909	138 km
E38 E391 P65	Chernihiv region – Shostka T 1907 – T 1908 – T 1912 – Bereza M02 – T 1915 – Hlukhiv R44 – Zarutskie T 1921 – Katerynivka checkpoint	72 km

Territorial highways

T 1901	Sumy H07 – H12 – P44 – P45 – P61 – T 1909 – Miropillya – Krasnopillya P45 – T 1918	58.6 km
T 1904	Bilopillia R44 – T 1906 – Terny R61 – T 1919 – Nedryhailiv H07 – Lipova Dolyna T 1913 – Poltava region	95 km
T 1906	Lantrativka T 1705 – Lebedyn T 1909 – T 1913 – Shtepivka H07 – T 1926 – Sosnivka R61 – Bilopillia R44 – T 1904 – Ryzhivka checkpoint	122.1 km
T 1907	Shostka P65 – T 1908 – T 1912 – Krolevets M02 – P60 – T 2503	35.1 km
T 1908	Shostka R65 – T 1907 – T 1912 – Znob-Novhorodske – Seredyna-Buda T 1915 – T 1924	84 km
T 1909	Amounts H07 – H12 – P44 – P45 – P61 – T 1901 – Swan T 1906 – T 1913	41.1 km
T 1910	Konotop R60 – R61 – T 1925 – Buryń T 1914 – T 1919 – Chumakove R44	43.7 km
T 1911	Mutin R60 – Putivl R44 – T 1920 – T 1921 – T 1922	31 km
T 1912	Shostka R65 – T 1907 – T 1908 – Yampol T 1915	20 km
T 1913	Romny H07 – R60 – T 1916 – Lipova Dolyna T 1904 – Lebedyn T 1906 – T 1909 – Trostianets H12 – T 1923 – Mezenivka R45	149.8 km

T 1914	Khmeliv R60 – Chernecha Sloboda R61 – Buryn T 1910 – T 1919	46.8 km
T 1915	Bereza M02 – P65 – Yampil T 1912 – Approach to Druzhba – Seredyna Buda T 1908 – T 1924 – checkpoint "Seredyna Buda"	69.2 km
T 1916	Romneys H07 – P60 – T 1913 – Big Tambourines	23.6 km
T 1918	Krasnopillia R45 – T 1918 – Pokrovka checkpoint	20.8 km
T 1919	Buryn T 1910 – T 1914 – Voskresenka – Terny R61 – T 1904	20.7 km
T 1920	Putivl R44 – T 1911 – T 1921 – T 1922 – Lynove – Nova Sloboda – Sofroniyivskiy Monastery	21.7 km
T 1921	Putivl R44 – T 1911 – T 1920 – T 1922 – Shalygino – Zarutske R65	39.7 km
T 1922	Putivl R44 – T 1911 – T 1920 – T 1921 – Kardashians – Heritage	12 km
T 1923	Trostianets H12 – T 1913 – Nitsakha – Druzhba R45	32.9 km
T 1924	Seredyna-Buda T 1908 – T 1915 – Arrival to the village of Khliborob – Arrival to the village of Vintorivka – Stara Huta – Vasylivka.	26.3 km
T 1925	Konotop P60 – P61 – T 1910 – Sosnivka	4 km
T 1926	Shtepivka H07 – T 1906 – Katerynivka – Tymchenky – Kushniry H07.	33.2 km
T 1927	Chernehchyna T 1705 – Zhuravne.	12.2 km
T 1928	Lutishche H12 – Kuzemin	10.3 km
T 1929	Okhtyrka H12 – P46 – T 1705 – Bakyrivka	13.8 km
T 1930	T 1705 – Dobrianske – Sydorova Yarura.	13.3 km
T 1931	Velyka Pysarivka R45 – T 1705 – Oleksandrivka – T 1705	5.9 km
T 1932	H12 – Zarechne	3 km

The total length of the network of public roads of national importance is 2.1 thousand kilometres (29.2% of the total length of roads in the region).

Transport services for residents of most rural settlements are provided by local roads (Order, 2021), in particular, regional roads with a total length of 2463.5 km (of which 2435.8 km are managed by the Sumy Regional State Administration) and district roads with a total length of 2665.8 km, of which 2664.6 km are managed by the

Sumy Regional State Administration (Appendix B). The total length of roads of local importance in Sumy region is 5.1 thousand kilometres (70.8% of the total length of roads in the region).

Accordingly, the total length of the network of public roads of national and local importance is 7.2 thousand kilometres, including 6.7 thousand kilometres of paved roads. The density of public roads of national and local importance is 281.9 km per 1 thousand square kilometres.

As of 01.01.2023, the route network of passenger transportation in Sumy region (Information, 2023) includes 499 public road (bus) routes, including 4 internationals; 28 interregional; 96 intercity intraregional; 224 suburban and 147 urbans. Passenger road transport on suburban and intercity intraregional routes is provided by 129 carriers, including 10 enterprises and 119 individual entrepreneurs. The route network covers more than 90% of the settlements of Sumy region (except for those where the road surface does not meet the safety conditions and where passenger transportation is suspended due to shelling). The volume of passenger traffic by road is declining.

Intercity bus passenger transportation in the region is provided by the central bus station in Sumy and a network of 7 bus stations operated by Sumyoblavtotrans LLC (Bilopillia, Buryn', Velyka Pysarivka, Hlukhiv, Lipova Dolyna, Konotop, Lebedyn, Nedryhailiv, Okhtyrka, Putivl', Romny, Shostka, Yampil'). Passenger traffic at the central bus station in Sumy is 100 people per hour (Strategy, 2020).

Intracity passenger transport by road is provided in 11 settlements of the region. There are 48 intracity bus routes, 19 trolleybus routes (Sumy) and 3 tram routes (Konotop). As of 01.01.2023, passenger transportation on public city routes in Sumy region is provided by 50 carriers, including 12 enterprises and 38 individual entrepreneurs operating based on agreements on the organisation of passenger transportation concluded with local executive authorities and local self-government bodies. There are 412 route buses and minibuses providing passenger transportation (as of 01.12.2021), including 336 in Sumy, of which 111 (26.9%) are adapted for the transportation of persons with disabilities, 59

trolleybuses, of which 35 (59.3%) are adapted for the transportation of persons with disabilities and 16 trams (Information, 2023).

There are railway lines in the region that belong to the state-owned company Ukrzaliznytsia, including its two branches: Southern Railway (in the southern part of Sumy region) and Southwestern Railway (in the northern and central parts of the region). The operational length of railway tracks within the region is 865 km (57 railway stations). The railway transport is subordinated to the Sumy Railway Directorate of the Southern Railway and the Konotop Railway Directorate of the Southwestern Railway. Passengers are dispatched at 54 railway stations out of 57. Passengers are dispatched in intercity traffic at 10 of them (Fig. 5.1). At the rest of the stations and stopping points, passengers are dispatched only in suburban traffic.

The largest railway junctions are Sumy, Konotop, Vorozhba, Khutir-Mykhailivskyy and Romny. The railway provides passenger transport to other regions of Ukraine, but passenger transport links with them remain unsatisfactory. The volume of passenger traffic by rail is declining. The largest passenger traffic remains on the routes Sumy-Kyiv, Sumy-Kharkiv and Shostka-Kyiv. The Bakhmach-Pasazhyrskyy – Lohvytsia railway provides passenger services only in suburban traffic.

Due to insufficient funding, the transport and operational condition of roads, bridges and road infrastructure does not ensure fast, comfortable, economical and safe transportation of passengers and cargo. Heavy vehicles are a major problem, as the road surface of the roads built in the last century was not designed to handle them. Carriers are allowed to exceed the current weight limits of 40 tonnes for national roads and 24 tonnes for local roads. The road surface cannot withstand such loads and is deformed, causing rutting, bumps and potholes that pose a threat to road safety and lead to premature destruction of even repaired road sections. Thus, out of the total length of public roads of local importance in the region, 3.6 thousand kilometres have lost their bearing capacity and 4.8 thousand kilometres do not meet the standard indicators for flatness (Strategy, 2020).

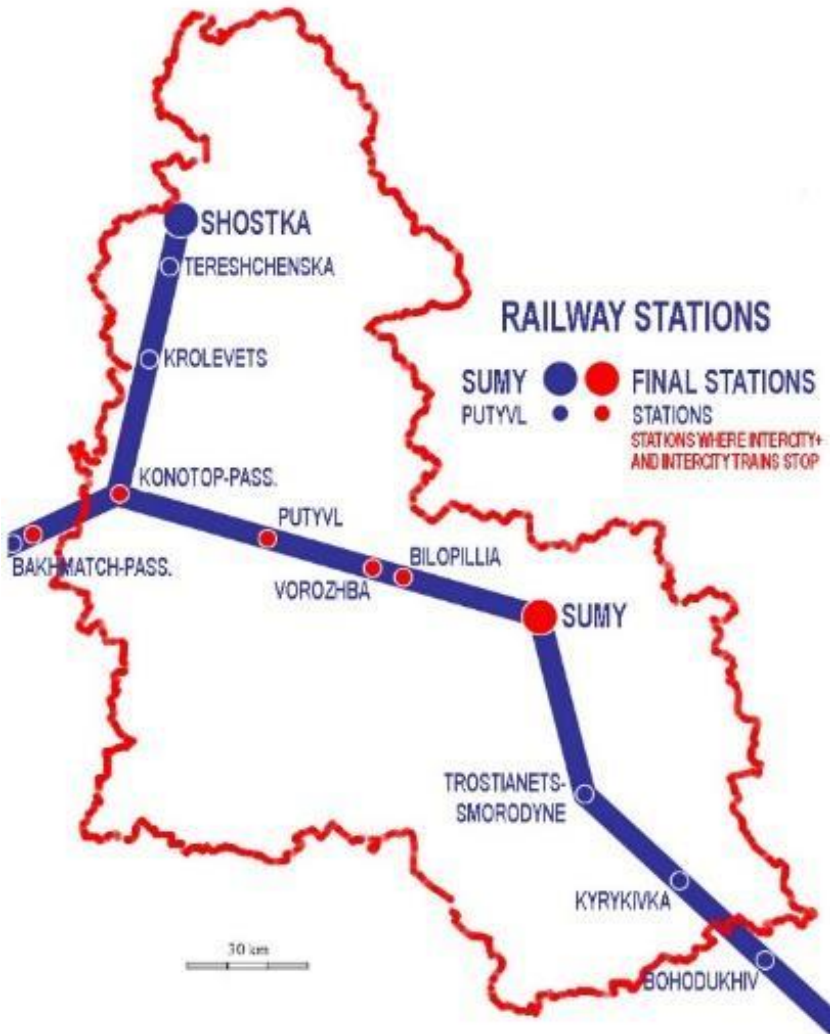


Fig. 5.1. Railway stations where passengers are departed in intercity traffic (own edition)

For the full functioning and effective development of transport services for the population of the region, it is necessary to increase the density of the main road network by creating additional roads in

the northern and southern parts of the region, as well as to take the necessary measures to reconstruct the existing transport network, expand the carriageways of highways and city streets used by public transport. Many roads, even those of national importance, which carry the largest traffic flow, were built to outdated technical requirements that do not meet modern freight and passenger traffic needs and require urgent repairs.

The ‘Social Taxi’ project to provide transport services to vulnerable groups of the population needs to be developed and Shostka has experience in implementing it (Regional, 2023).

There are many different methods to study the level of development of transport services. As stated in the publication by V. Burkun (Burkun, 2018), to analyse the development of the road transport system, it is necessary to take into account 3 components: economic, social and environmental. The social component involves the study of the following indicators: the volume of passenger transportation by road transport by type of connection (calculated in million passenger-kilometres), the number of road accidents, including fatal ones (calculated as the number of cases per 1000 inhabitants), the number of trips per capita of the population on average per year by road transport, consumer price indices (tariffs) for passenger transportation by road, transport mobility of the population (the ratio of the total passage of fat circulation in passenger kilometres to the population), transport discrimination of the population (the ratio of the number of residents of settlements whose transport accessibility to the centres of socially guaranteed minimum services exceeds the norm by 10%).

To study the territorial differentiation of transport provision of the Kirovohrad region by the level of provision of its communication routes, Y. Silchenko et al. (Silchenko, 2017) propose to use the indicator of transport network density, which is calculated as the ratio of the length of communication routes to the area of the region:

$$d_s = \frac{L}{S} \quad (5.2)$$

where: d_s – is the coefficient of transport provision of the region; L – is the length of communication routes, km; S – is the area of the

region, km².

Using the aforementioned formula, we calculated the transport network density in the Sumy region, which is 0.103. Among its five administrative districts, the highest transport accessibility coefficient is found in the Romny district – 0.129. The lowest coefficients are recorded in the Okhlyrka (0.090) and Shostka (0.091) districts.

As previously mentioned, transport accessibility is one of the key indicators of the development of social infrastructure in any region. The transport system provides access to medical facilities, schools, higher education institutions, cultural establishments, sports complexes and other essential social infrastructure. This is particularly important for residents of remote and rural areas, where access to these services can be limited without adequate transport connections. As noted in the scientific article by I. Khodykina et al (Khodykina, 2011), the availability of a region's road network is usually calculated as the ratio of road length to the area they cover, expressed in km/km² or km/1000 km². Another indicator used to reflect the road network's availability is the ratio of road length to the population living in the area, expressed in km/person or km/1000 people.

For example, O. Dziubynska et al (Dziubynska, 2014) propose using several methods for studying transport provision. The first method is the calculation of the ratio of the region's area to the total length of highways:

$$d_S = \frac{1000 \cdot L_E}{S} \quad (5.3)$$

where: L_E – length of the operational road network, km; S – area of the region, km².

However, in cases where the studied areas have the same or similar size, the need for transport will be greater in the area with a larger population. According to the second method, transport provision is determined by the ratio of the network length to the population size:

$$d_H = \frac{1000 \cdot L_E}{H} \quad (5.4)$$

where: LE – length of the operational road network, H – population of the region, ten thousand people.

However, a simple ratio of road length to area or to the population living in that area only provides a generalized view of road provision. In large cities, a relatively small area often contains a high concentration of people and in such cities, road provision is significantly reduced. This characteristic was noted by E. Engel, who developed a formula for road provision that takes this feature into account.

The Engel coefficient for studying the state of infrastructure provision in regions has been used in various studies by many researchers, including L. Sotnichenko in her scientific work (Sotnichenko, 2014), Yu. Silchenko et al (Silchenko, 2017) and others.

In the scientific work of V. Burkun (Burkun, 2018), methodological approaches to determining the efficiency of the national road transport system of Ukraine are considered. To assess the degree of provision of road and rail networks in the territory, the authors also propose using the Engel coefficients, which are determined by the following formula:

$$K_e = \frac{L}{\sqrt{SH}} \quad (5.5)$$

where: K_e – Engel coefficient, L – length of public roads with a hard surface at the end of the year, km; S – area of the territory, km²; H – population estimate at the end of the year, persons.

Using this methodology, we calculated the Engel coefficient for the administrative districts of Sumy region. Overall, the coefficient for the region is 0.077, which is the highest value. According to the calculations, the lowest coefficient is in Okhtyrka district, at 0.009.

Calculating the Engel coefficient allows for identifying areas with critical tension regarding road provision and assessing the level of road infrastructure availability in the region. However, as noted in

the article by R. Hudyma (Hudyma, 2013), this coefficient is comparative and therefore no normative indicators are provided for it. Its main drawback is that it is offset by the level of economic development of the region. According to S. Tulchynska and S. Kyrychenko (Tulchynska, 2017), the Engel coefficient can be modified to assess not only transport infrastructure but also social infrastructure as a whole.

For a more detailed characterization of the road transport provision in the Sumy region, the methodology described in the scientific work by Yu. Silchenko et al (Silchenko, 2017) was used. In addition to the Engel coefficient, this methodology also suggests using the Holz coefficient to account not only for the area and population but also for the number of settlements.

$$K_g = \frac{L}{\sqrt{SP}} \quad (5.6)$$

where: K_g – Holz coefficient; L – length of communication routes, km; S – area of the region, km²; H – population, thousand people; P – number of settlements, units.

Table 2 presents the calculations of transport provision for the population of the Sumy region according to the formulas mentioned above. As seen in Table 5.2, the Holz coefficient is highest in the Shostka and Sumy districts and lowest in the Romny district.

Table 5.2. Basic indicators for determining the level of transport services for the population in the Sumy region

Administrative unit	Density of the transport network	Transportation provision (S)	Transportation provision (N)	Holz coefficient	Engel coefficient
Konotop	0,104	104,42	26,16	4,077	0,017
Okhtyrka	0,090	90,28	26,16	4,156	0,009
Romny	0,130	129,80	35,40	3,615	0,016
Sumy	0,103	102,51	9,29	7,019	0,021
Shostka	0,091	91,35	27,72	8,219	0,014
Sumy region	0,103	103,36	22,62	4,010	0,077

Based on these indicators, it is possible to determine the level of connectivity in the territories served by different types of transport. However, as noted by the authors themselves (Silchenko, 2017), while these coefficients can be used for a comprehensive assessment of the territory, they provide an incomplete picture of the level of transport development, as they do not take into account the network configuration, the capacity of its elements, or the qualitative indicators of the transport network's performance.

The above-mentioned calculated indicators are important for assessing the level of connectivity in the territories. They can be used for a comprehensive evaluation of transport services in a region, as effective transport services promote social integration by ensuring connections between different settlements and fostering interaction among various population groups. This helps reduce social isolation, particularly in rural or sparsely populated areas. Additionally, a well-developed transport infrastructure reduces the time spent traveling to work, education, or services, which enhances the overall quality of life. It also facilitates access to cultural and recreational activities, enriching the cultural life of the region.

5.3 Development of healthcare infrastructure in Sumy region

When studying the level of development of social infrastructure, an important aspect is the study of healthcare services. The availability of modern healthcare facilities and other social welfare institutions contributes to the overall health of the population and plays an important role in disease prevention and maintaining social stability. Healthcare is an integral part of the social infrastructure, which is crucial for maintaining health, well-being and social stability in the region. It contributes to the quality of life, economic development and social inclusion, making the region more attractive for living, working and investing. An efficient healthcare system reduces healthcare costs associated with chronic diseases and disabilities, also reduces losses from temporary disability.

Currently, both Ukraine as a whole and its regions face problems with public health (high primary morbidity and prevalence

of cardiovascular diseases, respiratory diseases, digestive diseases, malignant tumors, etc.), which are caused by many factors, such as population ageing, lack of prevention, prevalence of bad habits, etc. Such negative trends lead to temporary incapacity for work, disability, significant economic losses, etc. It should be noted that the state of health of the population is also affected by the territorial organisation of medical institutions, which often does not meet the needs of residents of a particular region or in accessible and high-quality medical care.

In early 2023, the next infrastructure phase of healthcare reform began, with the main goal of forming a so-called capable network of healthcare facilities. The Ministry of Health, based on the experience of the Baltic countries as an acceptable model for use in Ukraine, defines a capable network as a system of medical institutions that provide medical services within a hospital district, in particular during emergencies, a state of emergency or martial law. These facilities allow for the proper quality, timeliness and accessibility of healthcare services to the population, as well as the efficient use of material, labor and other resources. The formation of a capable network means concentrating state support on the institutions that are part of this network. Public funding for repairs, reconstructions and the purchase of expensive equipment (such as angiography and magnetic resonance imaging) will be primarily directed to institutions in the capable network (although none of the institutions, whether in the network or outside it, are deprived of the opportunity to conclude contracts with the National Health Service of Ukraine (NHSU)).

A capable network of healthcare facilities is formed based on hospital districts, which, in turn, are divided into hospital clusters. Within the hospital districts, there are general, cluster and supercluster multidisciplinary hospital healthcare facilities, primary healthcare facilities, emergency and disaster medicine centres, as well as providers of other healthcare services (Dubyna, 2023).

An effective healthcare system is key in preventing and combating epidemics, natural and man-made disasters and other emergencies. It ensures readiness to respond quickly to threats to public health, reducing risks for the region. Accordingly, one Sumy

Hospital District was created in Sumy Region, divided into clusters according to the district principle (each administrative district is a cluster²). The regional centre will also have a separate cluster hospital to serve the urban population.

Supercluster healthcare facilities are multidisciplinary hospitals for adults or children with resources and technologies focused on providing medical care for the most complex and/or rare cases of diseases of the population and inpatient treatment. Supercluster institutions are created at the rate of no more than one per hospital district and serve as the main centre for organizing and providing medical and rehabilitation care to the population of the entire hospital district in the following directions: oncological, cardiology, psychiatric, phthisiopulmonary or infectious diseases, perinatal.

In total, supercluster facilities can operate in 28 directions of medical care:

1. obstetrics and gynecology (level III perinatal care);
2. anaesthesiology (intensive care in emergency conditions);
3. gastroenterology;
4. haematology;
5. neonatology;
6. endocrinology;
7. intensive care;
8. infectious diseases;
9. cardiology;
10. cardiac surgery;
11. combustiology;
12. neurology;
13. neurosurgery;
14. nephrology;
15. otolaryngology;
16. ophthalmology;

² The formation of hospital clusters is not related to the administrative-territorial reform. If, for example, high-quality roads appear in Sumy region, significantly changing the time it takes to deliver a patient to certain hospitals, the boundaries of hospital clusters will also change. Other factors may also influence the change in cluster boundaries.

17. orthopedics and traumatology;
18. palliative care;
19. pulmonology;
20. rehabilitation;
21. rheumatology;
22. vascular surgery;
23. therapy;
24. thoracic surgery;
25. urology;
26. surgery, including pediatric surgery;
27. maxillofacial surgery;
28. transfusiology.

This list of medical services is defined by the Cabinet of Ministers of Ukraine, but it can be expanded by the decision of the owner of the multidisciplinary hospital to the needs of the population.

The supercluster hospitals of Sumy region will include seven institutions:

1. Sumy Regional Clinical Hospital;
2. Regional Children's Clinical Hospital;
3. Regional Clinical Perinatal Center;
4. Medical Clinical Centre for Infectious Diseases and Dermatology named after Z.Y. Krasovitsky;
5. Regional Clinical Specialized Hospital;
6. Sumy Regional Clinical Cardiology Dispensary;
7. Sumy Region Clinical Oncology Centre.

A cluster healthcare facility is a multidisciplinary hospital that can meet the healthcare needs of the population in the most common diseases and conditions within the hospital cluster. The cluster hospitals will provide care to patients with moderate and severe illnesses. These facilities should be located so that they can be reached from any point in the cluster (district) within an hour or less.

A hospital cluster may have more than one cluster facility if each of them serves at least 120 000 patients. In regional centres and cities with a population of more than 300 thousand people, the number of cluster healthcare facilities is determined at the rate of one per 150 thousand patients.

Cluster healthcare facilities can operate in 20 directions of healthcare:

1. obstetrics and gynecology (II level of perinatal care)
2. allergology
3. anaesthesiology (intensive care in emergency conditions)
4. dermatovenerology
5. endocrinology (except for surgical interventions)
6. infectious diseases
7. cardiology, including interventional cardiology
8. neurology
9. neurosurgery
10. otolaryngology
11. pediatrics
12. rehabilitation
13. therapy
14. orthopedics and traumatology
15. urology
16. surgery, including vascular surgery
17. ophthalmology
18. palliative care
19. psychiatry
20. transfusiology

The cluster hospitals will include six medical institutions in Sumy Region: two in Sumy district (Central City Clinical Hospital and St. Panteleimon Clinical Hospital) and one in each of the other districts (Konotop Central District Hospital named after Academician Mykhailo Davidov, Okhtyrka Central District Hospital, Romny Central District Hospital, Shostka Central District Hospital).

The third level of secondary healthcare will consist of general hospitals – healthcare facilities that provide basic medical care to at least 40 000 patients of one or more territorial communities in a hospital cluster, taking into account that patients can reach it within 60 minutes at the latest, taking into account the quality of roads that may complicate accessibility.

General hospitals operate in six directions of medical care: anaesthesiology (intensive care in emergencies), neurology, infectious diseases, orthopedics and traumatology, therapy and

surgery.

The capable network of general hospitals in Sumy region also includes those facilities that do not serve the required 40 000 people, but in the areas where they serve there is a risk of operational encirclement, disruption of transport and logistics routes, accordingly, emergency medical services will not be able to deliver these patients to other facilities in time to receive medical care. Therefore, the general hospitals in Sumy region will include 10 former central district hospitals that did not become cluster hospitals. These include: 1. Bilopillia City Hospital; 2. Buryń' Hospital; 3. Hlukhiv City Hospital; 4. Krasnopillia Hospital; 5. Krolevets Hospital; 6. Lebedyn Hospital named after K.O. Zilbernyk; 7. Nedryhailiv Hospital; 8. Putivl' City Hospital; 9. Trostyanets City Hospital; 10. Yampil' Hospital.

Hospitals included in the capable network will have priority in receiving state funding for repairs, reconstruction and the purchase of expensive equipment at public expense. It is expected that they will receive equipment according to their role in the hospital district, so that it is constantly working and not idle, waiting for a patient.

According to the NHSU, in the second calendar quarter of 2024, all hospitals in Sumy Region made the following number of hospitalizations (this data can be used to assess the volume of inpatient care):

Sumy Regional Clinical Hospital – 4329,
Sumy Regional Clinical Oncology Centre – 3707,
Sumy City Council Clinical Hospital №5 – 3725,
Sumy Regional Council Clinical Hospital of St Panteleimon – 2442,
Central City Clinical Hospital of Sumy City Council – 2149,
Sumy Regional Children's Clinical Hospital of Sumy Regional Council – 2096,
Konotop Central District Hospital named after Academician Mykhailo Davydov of Konotop City Council – 1678,
Romny City Hospital of Romny District Council – 1489,
Sumy Regional Specialised Dispensary for Radiation Protection of the Population of Sumy Regional Council – 1458,
Okhtyrka Central District Hospital of Okhtyrka City Council –

1440,
Hlukhiv City Hospital of Hlukhiv City Council – 1224,
Shostka Central District Hospital of Shostka District Council –
1063,
Buryń Hospital named after Prof. M.P. Novachenko – 979,
Children’s Clinical Hospital of St. Zinaida of Sumy City
Council – 946,
Clinical Hospital № 4 of Sumy City Council – 930,
Lebedyn Hospital named after K.O. Zilbernik of Lebedyn City
Council – 868,
Krolevets Hospital of Krolevets City Council – 712,
Bilopillia City Hospital of Bilopillia City Council – 683,
Trostianets Town Hospital of Trostianets City Council – 668,
Konotop City Hospital of Konotop City Council – 630,
Regional Specialised Hospital in Hlukhiv of Sumy Region
Council – 614,
Clinical Perinatal Center of the Holy Virgin Mary of Sumy
City Council – 604,
Putivl’ City Hospital of Putivl’ City Council – 575,
Sumy Region Cardiology Dispensary of Sumy Region Council
– 563,
Nedryhailiv Hospital of Nedryhailiv Village Council – 560,
Yampil’ Hospital of Yampil’ Rural Council – 539,
Lypova Dolyna Hospital of Lypova Dolyna Rural Council –
359,
Krasnopillia Hospital of the Krasnopillia Rural Council – 316,
Medical Clinical Centre for Infectious Diseases and
Dermatology named after Z.Y. Krasovitsky of Sumy Region Council
– 311,
Seredyna-Buda City Hospital of Seredyna-Buda Rural Council
– 176,
Regional Clinical Perinatal Centre of Sumy Region Council –
160,
Sumy Regional Clinical Hospital of Veterans of War of Sumy
Regional Council – 139,
Shostka Children’s Hospital of Shostka City Council – 121,
Velyka Pysarivka Hospital of Velyka Pysarivka Rural Council

– 39,

Regional Clinical Phthisiopulmonary Centre (Stepanivka) of Sumy Region Council – 17,

Regional Clinical Specialised Hospital of Sumy Region Council (Romny) – 1.

Hospitals are more related to hospital districts and clusters and are not directly connected to all territorial communities. Of course, inhabitants of rural and village communities are also treated in hospitals, which are secondary level infrastructure for them, but most inhabitants of communities, especially rural and village communities, deal with primary healthcare in their daily lives.

As of 26.07.2024, the primary link of the capable network of healthcare facilities in Sumy region consists of 90 healthcare providers that have contracts with the NHSU, including 51 legal entities of communal ownership (Appendix C) – mainly municipal non-profit enterprises – primary healthcare centres of territorial communities (hereinafter referred to as POC). To provide primary healthcare, 622 primary healthcare sites have been established, including 171 medical care points (territorial hospitals, general practice outpatient clinics and village medical outpatient clinics). Medical care is provided by 585 primary care doctors. Including mobile, private medical facilities and individual entrepreneurs, primary healthcare is available from 741 doctors in the region. In addition, primary healthcare is provided by 455 paramedical obstetric centres and paramedical centres (POC/PC), health posts (HP) and medical care rooms (MCR)³ (Table 5.3).

³ Emergency rooms are available only at the Lebedyn primary healthcare centre. Lebedyn with locations in the villages of Mykhailivka, Vasylivka, Malyi Vystorop, Velykyi Vystorop, Vorozhba, Riabushky, Mezhyrich, Katerynivka, Budylka, Kamiane, Moskovskiy Bobryk, Shtepivka, Pidopryhory, Hryntseve, Pavlenkove.

Table 5.3. Primary healthcare facilities of the capable network in Sumy Region

Administrative district	The number of primary healthcare facilities of the capable network
Konotop	161
Okhtyrka	99
Romny	93
Sumy	156
Shostka	113
Total	622

Emergency medical care facilities complete the capable network of medical facilities, which includes 5 stations, 14 substations and 37 permanent locations for emergency (ambulance) teams.

Facilities that are not part of the capable network may continue to operate if they are maintained by territorial communities or as private or departmental medical facilities. As of 26.07.2024, primary healthcare is provided by 19 privately owned facilities (without individual entrepreneurs), which have 24 places of primary methodological care provided by 116 doctors. Among the most well-known in the region are LLC ‘Medea-Sumy’, LLC ‘Family Polyclinic’ (Romny), Treatment and diagnostic center ‘Zdravie’ (Konotop), LLC ‘My Doctor’ (Krolevets), LLC ‘Your Doctor – V.A.M.’ (Romny), LLC ‘Mira’ (Sumy), LLC ‘Medsoyuz+’ (Sumy), PE ‘Floris-S’ (Sumy), etc. Primary healthcare is also provided by 20 individual medical entrepreneurs who have relevant contracts with the NHSU, employing 48 doctors, including 4 pediatricians.

To characterize the component structure of the healthcare sector, we have identified the following types of institutions: hospitals that are not included in the list of general hospitals of the capable network, municipal medical outpatient clinics and general practice-family medicine outpatient clinics (at least 2 primary care physicians work there), rural health posts, paramedic station (separate structural units of primary care outpatient clinics that provide pre-hospital medical care to the population), health posts (care is provided by junior specialists with medical education (paramedic, nurse) and/or a doctor who provides irregular primary

healthcare on the days of his/her appointment (Fig. 5.2).

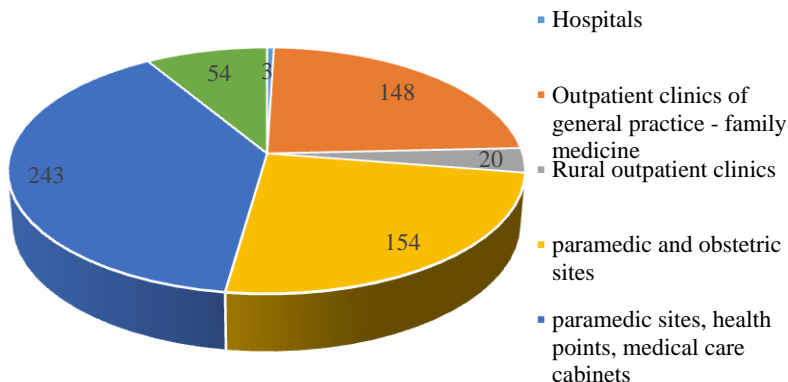


Fig. 5.2. Structure of the primary healthcare network in Sumy Region by type (units) as of 1 January 2023

The Sumy Regional Centre for Emergency Medical Care and Disaster Medicine operates to provide emergency medical care to the population (Website, 2024). This center has 5 stations in all administrative districts of the region.

The Central E(S)MD Station includes 4 substations: the first substation of the Central E(S)MD Station, Bilopillia, Lebedyn and Krasnopillia. In addition, there are permanent base points for the E(S)MD brigades in Sumy district: ‘Hospytalnyi’ in Sumy city, Khotyn’, Stepanivka, Nyzhnia Syrovatka, Yunakivka and Myropillia.

The Konotop E(S)MD station includes 3 substations: Buryń’, Putivl’ and Krolevets. This station includes the points of permanent basing of E(S)MD brigades: Dubovyazivka, Kozatske, Vyryvka and Sosnivka.

Okhtyrka E(S)MD station includes Trostianets and Velyka Pysarivka substations. In the territory of Okhtyrka district, there are 2 permanent base points for E(S)ME brigades in the villages: Hrun’ and Chupakhivka.

The Romny Emergency (Ambulance) Station operates two substations – Nedryhailiv and Lypova Dolyna. There are also two permanent stations for EMS teams in Khmeliv and Andriyashivka.

The northern territories of Sumy region are served by the Shostka EMS station. Emergency medical services are provided by 3 substations: Hlukhiv, Yampil' and Seredina-Buda. In addition, there are 3 permanent stations for EMS teams in Voronezh, Klyshky and Ivot.

The most widespread component of the healthcare network in Sumy region is paramedic and midwifery stations (Table 5.4). In total, there are 397 of them (including health posts), which is 63.8% of the total number of facilities in the network. The main purpose of these facilities is to provide pre-hospital medical care in one or more settlements where there are no other providers of free primary healthcare, to ensure proper access to it. It should be noted that not all of these facilities are staffed with medical personnel by the current standards.

Table 5.4. Typological structure of a capable network of primary healthcare facilities in administrative districts of Sumy Region (as of 1 January 2023)

Administrative district	Hospitals	Outpatient clinics of general practice – family medicine	Rural outpatient clinics	paramedical obstetric centers	Paramedical centers, health points, medical care cabinets	Stations, substations and base points of emergency (ambulance) teams
Konotop district		27	6	34	83	11
Okhtyrka district	1	26	4	16	45	7
Romny district	1	22	7	22	34	7
Sumy district	0	49	2	45	44	16
Shostka district	1	24	1	49	25	13
Total	3	148	20	154	243	54

POC and PC are separate structural units of outpatient clinics of general practice and family medicine (GPFM) or other units of the primary healthcare center or territorial hospitals that operate outside the network. There are 3 such hospitals in Sumy region: Velyka Pysarivka, which is now destroyed, Lypovo Dolyna and Seredyno-Buda, also 160 primary health centers and 20 village health centers (VHCs).

GPFM facility, which includes POC and PC, is the main unit in the functional component structure of the primary healthcare system that provides medical care (including medical consultation), diagnosis and treatment of the most common diseases, minor injuries, poisoning and other conditions, medical prevention of diseases and referral of patients for secondary and tertiary medical care and sanatorium treatment. All territorial communities of Sumy region have primary healthcare centres (Table 5.5).

The largest number of GPFM (15) has been established in Sumy city community, which is understandable given the large population of over 250 thousand people. 11 GPFM have been established in Shostka city community, although the population here is three times smaller. In this context, it is worth noting that according to the current Order of the Ministry of Health of Ukraine and the Ministry of Regional Development of Ukraine of 06.02.2018 No. 178/24 “On Approval of the Procedure for the Formation of Capable Primary Healthcare Networks”, a GPFM is established based on a population of 3000 people (Order, 2018).

However, this standard is not always met. For example, in Svesa settlement community with a population of more than 8000 people, only 1 PHC has been established, while in Andriyashivka village community, with approximately the same population, there are 3 PHCs. However, the above-mentioned order allows us to take into account the availability of existing public transport routes and the historical tradition of the territorial location of the place of primary healthcare provision when determining the territorial location of regular places of provision. Modern outpatient clinics provide daycare, individual heating, cold and hot water supply and take into account the needs of people with limited mobility.

Table 5.5. The network of GPFM in Sumy region

Territorial community	Population, persons (as of January 1, 2022)	Number of automated control systems
Konotop district		
Bochechky village community	4287	2
Burn' city community	19678	3
Dubovyazivka rural community	9733	3
Konotop city community	87403	3
Krolevets city community	35033	8
Nova Sloboda village community	13026	2
Popivka village community	13026	5
Putivl' city community	20358	1
Okhtyrka district		
Boromlya village community	4920	1
Velyka Pysarivka rural community	10009	5
Grun' village community	5271	3
Kyrykivka rural community	6064	2
Komyshi village community	2988	2
Okhtyrka city community	47642	2
Trostryanets city community	28107	4
Chernehchyna village community	9576	5
Chupakhivka rural community	5530	2
Romny district		
Andriyashivka village community	8368	3
Vilshana village community	4521	2
Korovynsi village community	3631	2
Lypova Dolyna rural community	12499	4
Nedryhayliv rural community	13946	3
Romny city community	54264	4
Synivka village community	4575	2
Khmeliv village community	5705	2
Sumy district		
Bezdryk village community	3425	2
Bilopillia city community	22579	3
Verhyia Syrovatka village community	6018	2
Vorozhba city community	8114	1
Krasnopillia rural community	20421	8
Lebedyn city community	41421	1
Mykolaivka rural community	11970	2
Mykolaivka village community	6685	2
Miropillia village community	4172	1

Nyzhnia Syrovatka village community	5782	2
Richki village community	4065	2
Sad village community	10000	3
Stepanivka rural community	10787	1
Sumy city community	267046	15
Khotyn' village community	6096	2
Yunakivka village community	5735	2
Shostka district		
Berezivka village community	4764	3
Hlukhiv city community	37931	2
Druzhba city community	5295	2
Esman' village community	5429	1
Znob-Novgorodske rural community	4690	1
Svesa rural community	8282	1
Seredyna-Buda city community	10308	1
Shalygine rural community	4131	1
Shostka city community	90591	11
Yampol' rural community	8011	1

The geographical specificity of the location of the elements of a capable network is reflected in the indicators of the provision of administrative-territorial units of the region with healthcare facilities (Table 5.6). Access to healthcare services contributes to social stability, as it ensures equal access to healthcare for all segments of the population, including vulnerable groups.

Table 5.6. Provision of primary healthcare facilities to a capable network of territorial communities in Sumy Region

Community	Community area per 1 institution (km ²)	The number of community residents (persons) per 1 facility
Bochechky village community	55.2	612
Buryn' city community	25.6	562
Dubovyazivka rural community	21.9	406
Konotop city community	20.2	17481
Krolevets city community	37.7	1030
Nova Sloboda village community	47.0	1184

Popivka village community	37.2	543
Putivl' city community	28.0	969
Boromlya village community	61.0	984
Velyka Pysarivka rural community	23.3	455
Grun' village community	34.7	753
Kyrykivka rural community	30.1	674
Komyshi village community	32.8	747
Okhtyrka city community	16.5	9528
Trostanets city community	32.8	1171
Chernehchyna village community	48.8	798
Chupakhivka rural community	24.9	503
Andriyashivka village community	34.9	523
Vilshana village community	28.9	502
Korovyntsi village community	23.7	454
Lypova Dolyna rural community	41.9	893
Nedryhayliv rural community	19.7	930
Romny city community	80.8	4522
Synivka village community	42.2	654
Khmeliv village community	27.0	475
Bezdryk village community	41.3	1713
Bilopillia city community	60.4	2509
Verhyia Syrovatka village community	34.9	1204
Vorozhba city community	30.5	1623
Krasnopillia rural community	34.0	756
Lebedyn city community	82.1	2071
Mykolaivka rural community	28.3	748
Mykolaivka village community	54.8	1337
Miropillia village community	16.4	417
Nyzhnia Syrovatka village community	55.0	1927
Richki village community	28.6	508
Sad village community	41.8	1111

Stepanivka rural community	18.5	1541
Sumy city community	18.3	14055
Khotyn' village community	29.4	1016
Yunakivka village community	68.4	1147
Berezivka village community	77.5	794
Hlukhiv city community	26.5	2231
Druzhba city community	25.2	1059
Esman' village community	42.3	418
Znob-Novgorodske rural community	36.1	361
Svesa rural community	49.2	1380
Seredyna-Buda city community	65.7	1145
Shalygine rural community	36.8	590
Shostka city community	43.3	3124
Yampol' rural community	65.4	1001
Sumy region	37.1	1600

To estimate the density of primary healthcare facilities in the capable network of communities in Sumy Region, we calculated the area of the community territory per 1 facility. In a way, this indicator is the average service area of a primary healthcare facility in a community.

On average, the service area of one facility in the region is 37.1 km² and varies by administrative district from 32.3 km² in Konotop and Okhtyrka districts to 44.1 km² in Shostka district. In terms of territorial communities, the highest density of primary health care facilities in the capable network is in Myropillia village community, Okhtyrka city community, Sumy city community and Stepanivka village community, where each facility has a service area of less than 20 km². A much larger service area is accounted for by a single healthcare facility in Yampol' rural community, Seredyna-Buda city community, Yunakivka and Berezivka village communities, where it is 65-75 km² and in Romny and Lebedyn city communities – even more than 80 km².

On average, one primary healthcare facility serves 1600

people. In terms of the number of inhabitants per 1 healthcare facility, Znob-Novgorodske and Dubovyazivka rural communities, Myropillia village, Esman' village, Korovyntsi village, Velyka Pysarivka rural,⁴ Khmeliv village communities stand out, with less than 500 people per healthcare facility.

A much larger contingent is served by primary health care facilities in city communities – district centers. But while in Shostka and Romny city communities, it is less than 5 thousand people, in the Okhtyrka city community there is almost 10 thousand and in Konotop city community, there are more than 17 thousand.

For a detailed study of the coverage of the territory of amalgamated communities by primary healthcare facilities, we calculated the coefficient of their territorial concentration by calculating the corresponding index, which is determined by the formula:

$$I_{tk} = \frac{p \cdot S}{P \cdot s} \quad (5.7),$$

where: I_{tk} – is the territorial concentration index, p – is the number of healthcare facilities in the community; P – is the number of primary healthcare facilities in the region; s – is the area of the community; and S – is the area of Sumy region.

A value of I_{tc} of less than 1.0 indicates a sparse network of healthcare facilities in a particular community; if the indicator is close to 1.0, we can talk about the density of healthcare facilities at the average regional level; above 1.0, the community is highly saturated with such facilities compared to this indicator.

As we can see, the healthcare sector in Sumy region continues to retain its territorially disproportionate nature, as established by previous studies (Kornus, 2015), despite attempts to reform it. Although some territorial communities did not create their POCs, but “joined” the former district POCs with their outpatient clinics and rural health posts (for example, primary health care facilities of Vilshana and Korovyntsi village communities are subordinated to the

⁴ Due to the destruction and constant shelling, the Velyka Pysarivska and Yamnenskyi primary healthcare centers of this community receive patients in Okhtyrka.

Nedryhailiv POC). Others have created joint primary healthcare centers, one for two, such as the Primary Healthcare Center of Andriyashivka and Khmeliv village councils. But still, small communities, especially those formed around cities and district centers, have a much higher concentration of capable primary healthcare facilities. For example, in Sumy and Okhtyrka city communities, the I_{tc} exceeds 2.0, while in Lebedyn city community it does not reach 0.5. On the other hand, the history of health care provision in a particular community and the location of the rural health posts (RHPs) before the reform have a significant impact. For example, in Myropillia village community, there are 10 facilities of a capable healthcare network (this community generally received the highest I_{tc} value of 2.25, as did Okhtyrka city community), while in Nyzhnia Syrovatka village community, which is the same size, there are only 3 (Fig. 5.3).

In general, the highest values of the Health Care Institutional Capacity Index are characteristic of the communities of Konotop and Okhtyrka districts and the lowest values are in Shostka district.

Given the human-centred nature of service provision by healthcare facilities, it is more important to determine the demographic burden on them, which follows from the correspondence of the location of healthcare facilities to the population distribution. This can be done with the help of the index of localization of healthcare facilities in amalgamated communities, which is calculated by the formula:

$$I_l = \frac{p \cdot N}{P \cdot n} \quad (5.8)$$

where: I_l – index of localization of health care facilities, p – number of facilities in the community; P – number of facilities in the region; n – population of the community, N – population of Sumy region.

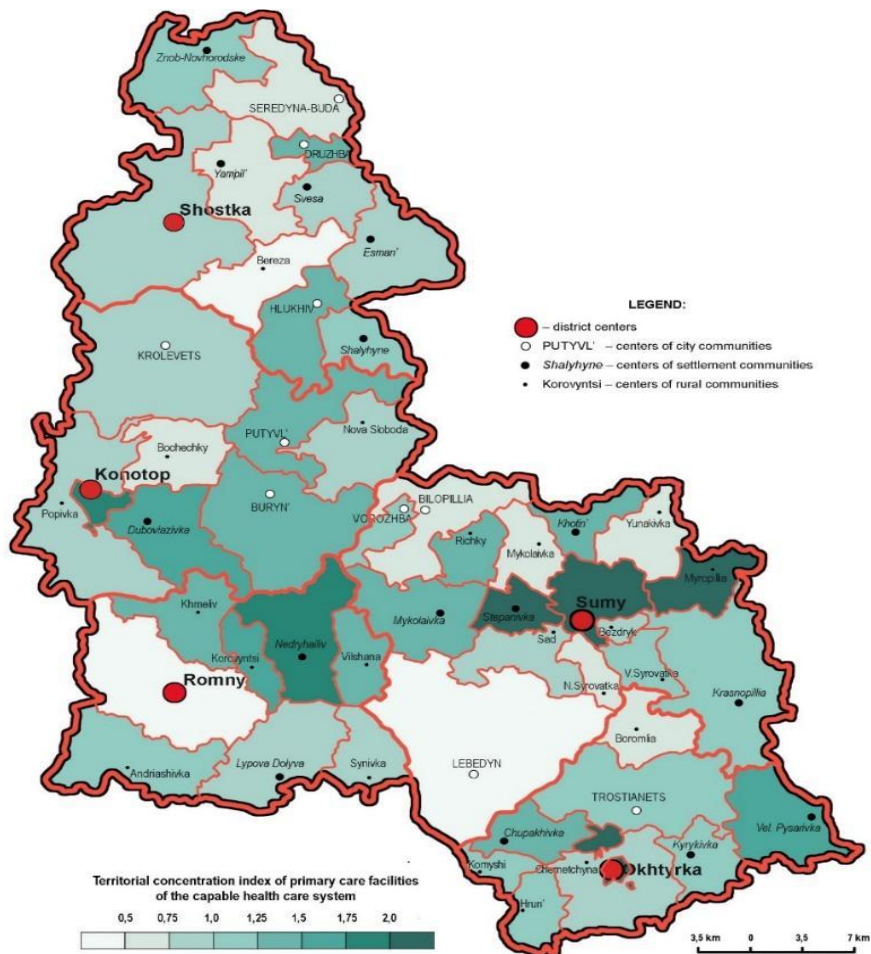


Fig. 5.3. Territorial concentration index of primary care facilities of the capable health care system of Sumy region (as of January 1, 2023)

Having analysed the geographical features of the territorial localization of the facilities of a capable healthcare network (Fig. 5.4) maintained by local communities, we found high and extremely high rates in communities with a small population. For example, in Myropillia, Korovyntsi, Khmeliv, Esman' Andriyashivka and Vilshana village communities with a population of less than 5

thousand people and in some others, the values of I_l exceed 3.5 and in some even 4.0. In the future, this will lead to a forced optimization of the capable network of healthcare facilities in those communities that have been “oversaturated” with medical facilities. It will be easier to maintain healthcare facilities in urban amalgamated communities, where the indicators of not only territorial concentration but also localization of healthcare facilities are lower (in Konotop, Sumy and Okhtyrka city communities, the value of I_l is 0.1-0.2). Accordingly, there are larger contingents of patients, which are now followed by funds and thus opportunities for the development of the primary care network.

It can be stated that today communities have formed a primary healthcare link. Primary healthcare is the main type of healthcare available in rural areas. The main problems of primary healthcare in rural areas are:

- irrational structure, management system and financing of primary healthcare; irrational use of the network (some rural health posts should be reorganised into outpatient clinics);

- outdated premises and equipment (most rural health posts have stove heating and bicycles remain the main means of transportation for health workers;

- low attractiveness of work in rural areas due to excessive workload and low remuneration (in most countries, remuneration of primary care physicians is much higher than in Ukraine)

- low level of provision of medical equipment, although the equipment of primary healthcare facilities with simple medical devices, such as electrocardiographs, is gradually improving;

- social problems of rural healthcare workers have not been resolved (a significant number of primary care physicians working in rural outpatient clinics, rural health posts and rural health centers do not have their housing).

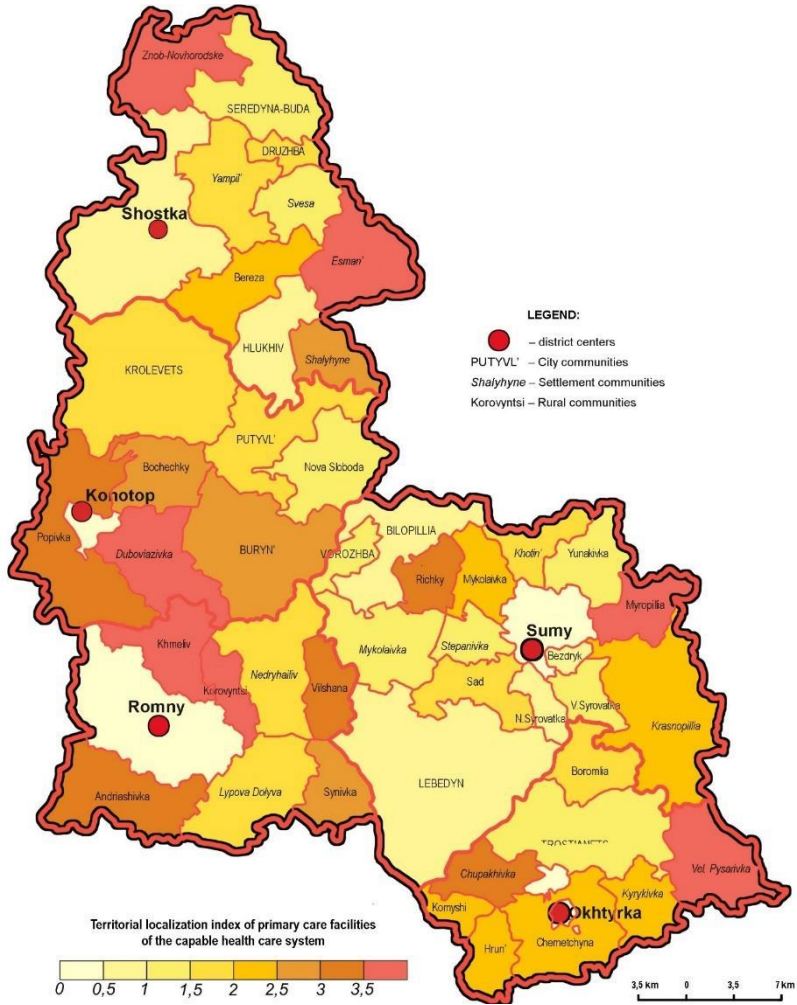


Fig. 5.4. Territorial localization Index of the healthcare facilities maintained by local communities in Sumy Region (as of 01.01.2023)

At the same time, the issue of the ability of territorial communities to maintain an extensive and capable network of primary healthcare facilities remains quite relevant. Population depopulation will lead to their optimization, especially in those communities that have inherited a large number of healthcare

facilities in villages that are gradually becoming sparsely populated (for example, the population of Derkachivka village of the Vilshana community, where the primary healthcare center is located, decreased from 712 to 476 people in 2001-2021 and this process will continue). Given the progressive aging of the population, programs should be developed to provide home-based medical care and palliative care, as is done in developed countries (Lee, 2024; Munday, 2024).

To summarize, the socio-geographical study of the capable network of local healthcare facilities in the territorial communities of Sumy Region revealed the following:

- the formation of a capable network within the framework of the healthcare reform is generally complete;

- the unique geospatial features of the healthcare network are determined by the history of healthcare provision (availability of existing primary healthcare facilities) in a given community and the peculiarities of the settlement network;

- the component structure of the primary link of a capable primary healthcare network is formed by five types of institutions: territorial hospitals, primary healthcare facilities, rural health posts, rural health posts and primary healthcare facilities. A separate link is formed by stations, substations and permanent locations of ambulance (emergency) medical care teams.

The territorial and functional structure of the network is represented by four different hierarchical levels: supercluster medical institutions, cluster (district) hospitals, general hospitals and a network of primary health care (medical) institutions.

The main problem of the functioning of primary healthcare institutions is to preserve the existing network, given the progressive depopulation of the population and to improve the material and technical base of these institutions. The findings of the study can be used in the creation and implementation of targeted healthcare development programs to improve the territorial accessibility of service provision.

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6 SPECIAL ECONOMIC ZONES AND THEIR ROLE IN SHAPING INVESTMENT AND INFRASTRUCTURE CONDITIONS FOR THE ECONOMIC RECOVERY OF UKRAINIAN TERRITORIES

6.1 Goals, development trends and main modifications of special economic zones

The recovery of Ukraine and its territories requires economic modernization, industrialization, the creation of modern infrastructure and the application of effective economic development tools, which are capable of transforming and improving the structure of the national economy. One of the tools that have proven to be sufficiently effective in these aspects, both in developed and developing countries, are special economic zones (SEZs). Special economic zones are geographically distinct areas within the national borders of a single country or cross-border regions of multiple countries, with special, more favorable regulatory and fiscal regimes and well-developed infrastructure (UNCTAD, 2019, p. 128).

SEZs are among the most popular economic policy tools for attracting foreign investment, creating new enterprises and jobs and supporting long-term economic growth. SEZs are established to address key development issues, such as low levels of industrialization, unemployment and low added value of domestically produced goods (Frick, Radouane, 2024). The listed goals for the establishment of zones are common to many countries that use SEZs as part of their economic strategy. At the same time, they can be significantly broader depending on national development priorities, such as promoting high-tech industries, facilitating knowledge transfer, developing infrastructure and high-quality logistics and ultimately achieving structural transformations. For example, Poland's SEZs have significantly contributed to structural changes in the country's economy. From the very beginning, they

were focused on attracting foreign investment in the development of new technologies, knowledge-intensive industries and relevant workforce skills. The SEZs of the Dominican Republic and Tunisia did not lead to radical structural transformations but proved effective in creating jobs. China's, Taiwan's and South Korea's SEZs prioritized the expansion of these countries' export capabilities over a long period by developing new industries and exploring new markets. Currently, SEZs in South Korea are part of the national industrial strategy and have a broader sectoral focus. They have significantly improved administrative efficiency, logistics and transportation are increasingly focused on innovation and skills development (Aaron, 2019, p. 30-31).

The goals for establishing zones also differ significantly between developed and developing countries. In the first case, most SEZs are customs-free zones whose main function is to eliminate tariffs and reduce the administrative burden of customs procedures on businesses to optimize supply chains. They are usually located near seaports, airports, or border corridors, equipped with services for providing warehousing and logistics support. In developed economies, SEZs are not as popular as in developing economies, since their business environment is attractive enough for investors even without preferences. Typically, countries with developed economies choose cluster approaches to economic development, avoiding the complex legal and institutional procedures associated with the establishment of SEZs (OECD, 2023, p. 26-27). In developing countries, on the contrary, zones are much more common and most of them are focused on attracting foreign investment (UNCTAD, 2019, p. 137-139). Since the overall investment conditions in these countries are uncompetitive and economically unattractive, they attempt to offset this disadvantage through SEZs.

It is considered that the first modern economic zone was established in Brooklyn, based on the New York naval shipyard, in 1937. This zone, along with other similar zones that emerged in various ports across the United States (such as New Orleans, San Francisco and Seattle), was aimed at promoting exports. The first European zone, the Shannon Free Zone in Ireland, was founded in 1959 by the Irish government to repurpose Shannon International

Airport. Following the advent of jetliners capable of long-distance travel, the airport was no longer in demand as a refueling hub. In Latin America and Asia, the development of zones began in the mid-1960s, initially in Colombia and the Dominican Republic, as well as in India and China, before subsequently spreading to other countries in these regions (The World Bank, 2017, p. 11).

The number of SEZs continues to grow, with these processes significantly accelerating in recent decades (Fig. 6.1). Currently, there are approximately 7,000 zones worldwide, employing over 100 million people (UNCTAD, 2022). SEZs have gained the most popularity in Asia, where around 80% of all zones globally are concentrated (UNCTAD, 2019, p. 138), particularly in China, where SEZs are widely and successfully utilized as a tool for industrial development. China’s rapid economic growth is often attributed to SEZs, with exports from these zones currently accounting for approximately 20-25% of the country’s GDP (Simo, 2023).

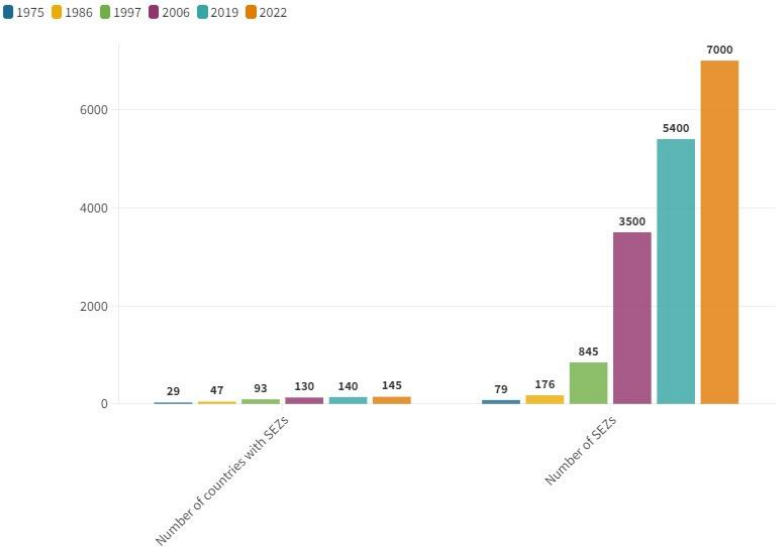


Fig. 6.1. Trends in SEZs within the Global Economy (Number of Countries with SEZs and Total Number of SEZs)

Source: Devised by the authors based on (UNCTAD, 2019, p. xii; UNCTAD, 2022)

SEZs take various forms and names, table 6.1 presents the types of zones that have gained the most widespread recognition globally. In addition to the aforementioned types, SEZs also include specialized economic zones, such as customs-free zones, transit zones, investment promotion zones, free banking zones, free insurance zones, free medical zones, free tourist zones, etc. SEZs undergo continuous changes and modifications; however, certain key characteristics remain common to them (OECD, 2023, p. 27):

1. Spatial: a specific and well-defined geographical area within the national territory or legal jurisdiction.

2. Regulatory: a regulatory framework distinct from the broader economy, often involving special customs and tax regulations. The business environment in the zone is characterized by more liberal policies and more efficient administrative procedures, namely exemption from or reduction of tax rates, implementation of tax holidays, accelerated depreciation, exemption from the payment of import and/or export duties on all or a range of goods, application of expedited licensing procedures, obtaining construction permits, minimization of bureaucratic procedures and others.

3. National governance of SEZs: a dedicated governance and institutional framework ensuring effective management of the zone.

4. Amenities: infrastructure support, including physical facilities, services and utilities, as well as financial or fiscal incentives to attract and retain businesses. Infrastructure support is an essential feature of SEZs, particularly in developing countries, where the basic infrastructure outside these zones is often underdeveloped.

For instance, the *DMCC free zone* in the United Arab Emirates (DMCC, 2024) offers businesses a zero corporate tax rate, a prime location in the heart of Dubai with full access to modern transportation, technology and business infrastructure, a fast and easy registration process, a wide range of flexible and affordable licensing options and other services. As of 2024, this zone hosts over 24,000 resident companies representing more than 180 countries and specializing in over 900 types of activities, including Baker Tilly, Dhamani, Electrolux, Hikvision, Orion Systems and Sepco.

Table 6.1. Most Common Types of Special Economic Zones

Type	Goals of creating, priority activities	Definitions	Examples
Free Trade Zone/Free Zone	<i>Goal:</i> stimulating international trade and investment. <i>Priorities:</i> manufacturing, trade and logistics; re-export	Designated areas where import taxes are waived and regulatory requirements are eased to encourage new businesses and attract foreign investments	<ul style="list-style-type: none"> ▪ Shannon Free Zone (Ireland); ▪ Port of Hamburg Free Zone (Germany); ▪ Shanghai Free Trade Zone (China); ▪ Jebel Ali Free Zone (UAE); ▪ Chennai Free Trade Zone (India); ▪ Port Klang Free Zone (Malaysia)
Export Processing Zone	<i>Goal:</i> Enhancing export-oriented manufacturing. <i>Priorities:</i> manufacturing, logistics and re-export	Duty-free zones dedicated to export-oriented manufacturing, typically offering export subsidies through tax exemptions and imposing little to no export quotas	<ul style="list-style-type: none"> ▪ Korean Export Processing Zone (Republic of Korea); ▪ Madras Export Processing Zone (India)
Border Economic Zone	<i>Goal:</i> facilitation of cross-border trade, investment and economic cooperation between neighboring countries. <i>Priorities:</i> trade, logistics and manufacturing	Economic zones situated near international borders, designed to promote cross-border trade and attract investment	<ul style="list-style-type: none"> ▪ Pingxiang Cross-border Economic Cooperation Zone (China, Vietnam); ▪ Thai-Malaysian Special Border Economic Zone (Thailand, Malaysia); ▪ Mexican Maquilladoras (Mexico)

Freeport	<i>Goal:</i> promotion of international trade and attraction of investment. <i>Priorities:</i> manufacturing, tourism and other related activities	Government-designated area where import tariffs are significantly reduced or eliminated, aiming to boost economic growth and trade	<ul style="list-style-type: none"> ▪ Solent Freeport (United Kingdom); <ul style="list-style-type: none"> ▪ Luxembourg Freeport; ▪ Geneva Freeport; ▪ Monaco Freeport
Enterprise Zone	<i>Goal:</i> business support, regional economic growth, job creation. <i>Priorities:</i> manufacturing, technology, banking and logistics	Geographic area, typically an economically distressed or inner-city location, where the government provides incentives to attract new businesses	<ul style="list-style-type: none"> ▪ Newhaven Enterprise Zone (United Kingdom); ▪ Urban Enterprise Zone (New Jersey, USA)
Industrial Park	<i>Goal:</i> industrial development/diversification, regional economic growth. <i>Priorities:</i> manufacturing, technology and logistics	A parcel of land that has been developed and divided into plots based on a detailed plan, complete with roads, transportation links and public utilities and sometimes shared facilities, designed for use by a cluster of manufacturers	<ul style="list-style-type: none"> ▪ Elk Grove Village, Cedar Port Industrial Park, TexAmericas Center (USA); ▪ Suzhou Industrial Park, Shenzhen Nanshan Robotics Industrial Park (China); <ul style="list-style-type: none"> ▪ Bucharest West (Romania); ▪ Bor (Czech Republic); ▪ Industrial Park Poland (Poland)

Source: Devised by the authors.

Another good example is the *Jebel Ali Free Zone (Jafza)*, one of the leading free zones globally and the first zone established in the United Arab Emirates in 1985. *Jafza* received top recognition at the prestigious fDi Global Free Zones of the Year Awards 2023, earning the “*Excellence Award for Sustainability*” and the “*Excellence Award for Non-Fiscal Incentives*” in the global category, along with the title of “*Industrial Champion*” in the Middle East. The global recognition for non-fiscal incentives highlights the zone’s cutting-edge manufacturing and logistics infrastructure, its world-class multimodal facilities at Jebel Ali Port and adjacent airports and the extensive range of support services available to businesses. *Jafza* is dedicated to facilitating the transition towards clean energy, which includes setting ambitious targets for reducing carbon emissions by 28% by 2030 and achieving net-zero emissions by 2050. This free zone is a key strategic hub for over 10,000 companies, including more than 100 Fortune 500 entities. The free zone provides comprehensive services tailored to major industries such as automotive and spare parts, healthcare and pharmaceuticals, food and agriculture, petrochemicals, logistics, retail and e-commerce (Jafza, 2023).

One more example is the *Shannon Free Zone* (Shannon Chamber, 2024), which covers approximately 250 hectares, contains 200 manufacturing and office buildings and is strategically located near Shannon Airport, between the cities of Limerick and Ennis, within convenient reach of Dublin. The zone is home to 100 companies (including Intel, Jaguar Land Rover, Lufthansa and Zimmer Biomet), providing 7,000 jobs. Their annual trade turnover amounts to around €3 billion. The zone specializes in aviation, ICT, engineering, pharmaceuticals, medical devices and international services.

6.2 International experience of SEZs' operations and their contribution to infrastructure development

The experience gained over nearly ninety years of special economic zones' operations has revealed critical lessons that must be considered when assessing the potential for creating a new SEZ, including the need for a careful evaluation of capital expenditures.

1. SEZs typically undergo an incubation period before achieving their objectives and delivering benefits. This period usually lasts from 5 to 10 years and for developing countries, it may extend even longer. Therefore, a cautious approach must be applied when establishing zones and immediate effects should not be expected (Zeng, 2021, p. 8). *First and foremost*, the goals of establishing SEZs must be clearly defined, such as attracting investments, creating jobs and stimulating industrial development, which will enable the implementation of specific measures aimed at achieving these objectives. The goals of SEZs should align with the strategic development objectives of the country, thereby enhancing their chances of success. A study (Alcorta, Taffere, 2020) emphasizes that the success of these zones also depends on the coherence and complementarity of SEZs with other economic policy tools. *Secondly*, governments must be prepared to support the zones on a long-term basis, even if the initial results of their operations are modest. Although the government cannot indefinitely cover the costs of the zones, it can establish legislative, fiscal and regulatory conditions that lead to the zones' self-sufficiency and effectiveness. This perspective is shared by leading urban experts Alejandro Riaño, Tony Venables and Xiaolan Fu, who underscore the crucial role of government in ensuring the success of SEZs: the government must closely collaborate with investors and remain attentive to their needs (Healy, 2018). *Thirdly*, the successful formation and management of SEZs require highly qualified specialists from various fields who can provide professional assistance while considering current challenges and opportunities. A strong technical team is a key factor in the success of SEZs.

2. The modern global economic environment is significantly different from that in which the first economic zones began

operations. Contemporary SEZs compete not only at the national level but also on a global scale. Investors have a vast array of choices among different countries and regions; therefore, the conditions offered in a zone must be significantly better than those in other jurisdictions. In addition to favorable tax conditions, investors pay attention to the availability of developed infrastructure, modern production facilities, a highly skilled workforce, ease of doing business and responsiveness in addressing issues.

3. A common practice worldwide is to provide investors in SEZs with extensive government subsidies. According to observations by experts from The World Bank (The World Bank, 2017, p. 37-38), out of 553 randomly selected SEZs globally, 375 offer a 100% exemption from corporate income tax; in 97 zones, the tax benefit depends on the type of economic activity, the volume of investment, or the number of jobs created by the resident enterprise. Additionally, in 38 zones, investors are offered a reduced fixed corporate tax and only 43 zones do not provide any corporate tax incentives to investors, which accounts for less than 10% of the total number of surveyed zones. Among other fiscal incentives, 303 out of 553 zones offer investors exemption from import duties on both capital equipment and materials; 223 zones provide such exemptions only for capital equipment, while 27 zones do not offer any duty-free incentives.

At the same time, relying solely on fiscal incentives without addressing other essential factors for establishing an economic zone can lead to temporary improvements in the regional economic situation. However, it is unlikely to achieve a sustainable and long-term impact merely through these incentives. The most successful SEZs globally are seamlessly integrated into the national economy and closely connected to global markets. For instance, South Korean SEZs are distinguished by their strong ties with local suppliers. Additionally, the availability of modern infrastructure within the zones, characterized by good road, rail and port connectivity, is a critical condition for their effective operation.

Special economic zones require robust infrastructure to facilitate cross-border connections, enhance living standards and encourage both trade and investment. This infrastructure can be

divided into two categories: soft and hard (The World Bank, 2010). *Soft infrastructure* encompasses institutional services like education, healthcare and workforce development, while *hard infrastructure* refers to tangible assets such as transportation networks, bridges, airports and telecommunications systems (Fig. 6.2). SEZs should not be viewed as isolated enclaves within the economy; instead, they should be regarded as integral components that connect the region in which they are located with the broader national economy and neighboring border areas.



Fig. 6.2. Bridge and roads at Sihanoukville SEZ in Cambodia as an example of hard infrastructure

Source: Open Development Mekong, 2019.

Thus, poor infrastructure or lack of it, even in the presence of favorable tax conditions, can become a significant barrier to the successful development of SEZs, preventing their successful integration into the regional and national economic system as a whole. Regardless of tax preferences, a lack of adequate infrastructure in the zones makes them unattractive to investors and businesses. In many countries, there are examples of SEZs that have

proven to be ineffective and have not played a significant role in economic growth due to inadequate infrastructure. This has been notably observed in Africa, where unreliable electricity supply and considerable distances from ports have led to the failure of many economic zones. Many SEZs in Southeast Asia suffer from poor planning and have turned into isolated enclaves with limited connections to the national economy. For instance, the development of roads intended to support the Dawei SEZ has adversely affected local communities, causing disruptions due to a lack of information, negative effects on livelihoods and land seizures (Open Development Myanmar, 2021). In India, there are both successful and unsuccessful instances of SEZs. Many of them have faced challenges such as bureaucratic formalities, infrastructure deficiencies, regulatory complexities and underutilization of land. At the same time, there are contrasting examples like the Mundra SEZ, which has gained significant benefits from its well-functioning private seaport, strong logistical connections, supporting infrastructure and economic advantages, namely a full exemption on export profits granted for the first five years, followed by a 50% exemption for the next five years; exemptions are provided for excise duty, customs duty, service tax, VAT, stamp duty and lease tax; exemption from electricity duty is granted for 10 years, beginning on the date operations commence, among others. Mundra has developed into a premier location for business, industry and quality living, thanks to its strong social infrastructure (Adani. Ports and Logistics, 2024; Arora, Kashyap, 2024). Therefore, the success of SEZs is critically dependent on their location and infrastructure.

4. Excessive ambition and overestimation of capabilities are often observed in countries attempting to use SEZs as tools for rapidly addressing structural issues. This is usually a consequence of unrealistic assessments of the available resources and the potential of the territory where the economic zone is planned to be established. For instance, some economic zones around the world aimed at developing high-tech industries without considering the lack of relevant professional expertise and industry profiles at the local level. A notable example is Kazakhstan, where the initial decision was made to develop high-tech economic zones despite the shortage of

locally qualified personnel. This resulted in delays in launching production facilities and reliance on foreign specialists, significantly increasing costs and slowing the pace of development of the economic zones. Consequently, the country's public policy was adjusted by adopting a more realistic approach that took into account the available resources and territorial specializations. It is important to note that the lack of local specialists with the necessary skills is encountered in many other SEZs globally, such as in India and African countries and this is an area that needs to be prioritized.

5. SEZs typically occupy large land areas, which are provided to investors at below-market rates, creating risks of land misuse for purposes other than those intended. In such cases, economic zones become a means for easy enrichment and abuse of state support. To prevent this, it is necessary to establish clear criteria for granting state assistance to zone investors. For instance, in Poland, a support decision in the form of tax exemptions is granted for the implementation of new investments that meet specific quantitative and qualitative criteria. According to the (Council of the European Union, 2019), new investments in tangible fixed assets or intangible assets should relate to:

- the establishment of a new enterprise;
- the increase in the production capacity of an existing enterprise;
- the diversification of production of an existing enterprise;
- the general change in the production process of an existing enterprise.

The *quantitative criteria* (minimum eligible costs) are determined by the unemployment rate in the district (poviat) where the investment will take place: the higher the unemployment rate, the lower the required costs. These criteria also depend on the size of the enterprise.

There are two *qualitative criteria*: sustainable economic development and sustainable social development (Table 6.2). An entrepreneur undertaking a new investment will be deemed to have satisfied the qualitative criteria once they achieve a certain number of points (based on location, as shown in Fig. 6.3), with at least one point required for each criterion.

Table 6.2. Qualitative criteria for receiving public aid in Polish SEZs

Sustainable economic development		
	Manufacturing sector	Business services sector
Compliance with the current national development policy, where Poland may gain a competitive advantage	Investments in projects from the following sectors: 1) selected food products; 2) means of transport; 3) professional electrical and electronic equipment; 4) aerospace sector; 5) hygiene products, medicines and medical products; 6) machinery; 7) material recycling of raw materials and modern plastics; 8) eco-buildings; 9) professional services; 10) professional telecommunication and information services; 11) inclusive smart specializations of the voivodeship the investment is planned in	
R&D activity	Pursuing research and development activities	
Professional activation	Professional activation through: 1) creating an on-site crèche or kindergarten; 2) covering the costs associated with the child's stay in care and educational institutions or 3) employing persons with a disability certificate	
Regional networking	Cooperation with suppliers, co-operators	
Robotisation and automation of processes	Purchase of an industrial robot	
Green energy	Investment in renewable energy sources	
Size of enterprise	Possessing the status of a micro, small or medium-sized enterprise	
National Key Cluster	Membership of a National Key Cluster	Not applicable
Sustainable economic development		
	Manufacturing sector	Business services sector
Creating high quality jobs	Creating specialized jobs in order to pursue an economic activity covered by the new investment and offering secure	Creating well-paid jobs and

	employment	offering secure employment
Low negative environmental impact	Pursuing an economic activity with low negative environmental impact	
Investment location	Locating the investment: 1) in medium-sized cities losing their socio-economic functions and in municipalities bordering these cities; 2) in poviats or cities, with poviat status where the unemployment rate stands at least 160% of the national average unemployment rate (excluding those cities where the voivode or the parliament of the voivodeship are seated)	
Support in gaining additional education	Supporting the acquisition of knowledge and vocational qualifications and cooperating with vocational schools	
Care for employees	Improving employees welfare	

Source: Polish Investment & Trade Agency, 2024

The maximum level of state aid provided as a corporate income tax or personal income tax exemption is determined based on the regional aid map for 2022-2027, which specifies the percentage of costs that qualify for regional assistance (Fig. 6.3). Moreover, for medium-sized, small and micro enterprises, support is increased by 10 and 20 percentage points, respectively.

In the context of the rapid unfolding of the Fourth Industrial Revolution and the development of green and digital technologies, a *new generation of SEZs* is emerging that leverages the advantages of the green and digital transitions and creates opportunities for developing countries. Some SEZs in these countries are already standing out among traditional zones by promoting the principles of the circular economy, developing and implementing net-zero strategies and adopting the International Framework for Eco-Industrial Parks. This framework requires industrial parks to implement resource-efficient practices and report on environmental performance based on indicators such as energy efficiency, renewable energy supply and the reduction of greenhouse gas emissions (The World Bank, 2021). For example, in 2015, Egypt

established the Suez Canal Economic Zone to attract foreign investment. The vision of the zone is to “utilize the huge potential of the Suez Canal and the surrounding land to develop an efficient, competitive and eco-friendly business environment, generating job opportunities, developing a global center for maritime transport and logistics services, an industrial hub and a gateway for trade between East and West” (SCZONE, 2024). Currently, the country aims to become a global hub for green hydrogen production, combining its significant solar resources with its unique location at the heart of global trade routes.



Fig. 6.3. Regional state aid map 2022-2027 for Polish Special economic zones

* Maximum intensity: 50%; 40%; 30%; 25%; 0% (some municipalities 25%-35%).

Source: Polish Investment & Trade Agency, 2024

Similarly, digitalization is transforming the nature of production. Artificial intelligence, big data, robotics and other digital

technologies are becoming critically important for productivity and competitiveness. As highlighted by (Vyshnevskiy et al., 2024, p. 7), the role of artificial intelligence is not only growing but has already reached a fundamental impact on various spheres of societal activity. Two leading digital technologies are particularly relevant for SEZs (Kamiya, Kratzsch, Dutt, 2024; The Alan Turing Institute, 2024; UNIDO & WAIPA, 2023, p. 74):

– *digital twins* create a virtual representation of an object or process and can range from a virtual replica of a single structure, such as a bridge, to more complex infrastructures like an entire city. Digital twins offer insights into how an object or process functions, enabling significant improvements in its performance. They can be used, for instance, in industry to create virtual prototypes and test them before actual production, allowing companies to save resources and optimize processes. The Alan Turing Institute in the UK has launched an initiative to establish an interdisciplinary research network involving stakeholders from academia, government and industry to explore and develop digital twins across various sectors – from agricultural modeling to aerospace engineering;

– the *metaverse* represents the next step in the development of virtual collaborative spaces (customized digital worlds) where different participants can interact as avatars, regardless of their physical location, provided they have internet access. For example, in virtual reality, it is possible to plan and model new production processes by virtually recreating factories, testing production layouts, experimenting with different approaches and assessing their costs and benefits. Investment agencies in developing countries are gradually increasing their use of modern digital technologies to promote their countries and SEZ sites. According to recent surveys, 9% of agencies in African, Caribbean and Pacific countries are using virtual reality, while 4% are utilizing the metaverse, with 25% of agencies planning to adopt these technologies in the near future.

The combination of natural resources and modern technologies could offer promising opportunities for developing countries, particularly in SEZs, by compensating for their remoteness from centers of knowledge, technology and innovation, provided that there is a well-developed infrastructure and proactive state policies.

According to experts (Kamiya, Kratzsch, Dutt, 2024), access to clean energy and internet connectivity will play a crucial role in the success of future SEZs. Therefore, investments in information and communication technologies and renewable energy infrastructure should be prioritized. To remain competitive, traditional export-oriented zones must also shift away from models relying on low-paid and low-skilled labor, which in the past was considered the primary factor for attracting investments, towards models based on modern technologies and highly qualified personnel. This transition will enhance the efficiency of production processes and strengthen the positions of SEZs and their host countries within global value chains.

6.3 Experience in the functioning and feasibility of the restoration of SEZ activities in Ukraine

Ukraine has an ambiguous experience in establishing special economic zones. According to the Law of Ukraine "On the General Principles of Creating and Functioning of Special (Free) Economic Zones" (1992; effective until July 27, 2022), along with specific laws enacted for each zone, 11 SEZs were created in the country from the late 1990s to the early 2000s. These laws introduced preferential tax, customs, currency, financial and other regimes for economic activities within the zones. Investors were granted various combinations of incentives, including a special customs zone regime, exemptions from profit taxation, investment taxation, import duties and value-added tax, as well as exemptions from the mandatory sale of foreign currency earnings, land rent and contributions to certain budget funds.

Ukrainian SEZs have suffered a reputational blow due to the illegal activities associated with the SEZ "Donetsk", which have fostered a negative perception of this instrument within the country. However, the experiences and outcomes from other zones indicate that the average multiplier effect of tax incentives from their activities was approximately 5. This means that for every hryvnia the state spent to support the zones, five hryvnias were returned to the budget. This occurred despite significant gaps in the regulatory

environment and the infrastructural weaknesses of Ukrainian zones.

It is particularly noteworthy to mention the SEZ "Transcarpathia," which was established with the aim of attracting investments, developing international economic ties, increasing the export of high-quality goods and services and building modern production and transportation infrastructure in the region (according to the Law of Ukraine "On the Special Economic Zone 'Transcarpathia' No. 2322 dated March 22, 2001). The zone had a favorable geographical location – near the borders with Poland, Hungary, Slovakia and Romania – which provided businesses with significant advantages compared to other similar territories. The aforementioned law guaranteed a special operational regime in the zone for 30 years and introduced tax benefits and customs preferences for investors. Specifically, newly established enterprises and those undergoing restructuring, with investments equivalent to no less than USD 250,000, were exempt from profit taxation. From the third to the fifth year, the profit of these enterprises was taxed at a rate of 50% of the current tax rate. As a result of the zone's establishment, in 2004, Transcarpathia ranked first in terms of investment activity dynamics and fourth in terms of direct foreign investment per capita, amounting to USD 62.7 million. By 2008, the volume of investments increased more than fivefold, reaching USD 365.3 million. In the first three years of the SEZ "Transcarpathia," over 30 local enterprises were modernized and major corporations such as Volkswagen AG, Audi AG, Škoda Auto and YAZAKI were attracted, leading to the creation of more than 19,000 jobs and ensuring the payment of 15% of the total tax revenues in the region, despite the tax preferences (Офіційний портал Верховної Ради України, 2024).

However, in 2005, with the enactment of the Law of Ukraine "On the State Budget for 2005," all tax incentives for enterprises within the zone were abolished. This decision undoubtedly undermined investors' confidence in the Ukrainian government, which effectively reneged on its commitments. As a result, since 2005, no investment projects have been registered in the region, resulting in the Transcarpathian region losing the opportunity to attract planned investments amounting to USD 1.2 billion and the

potential creation of approximately 6,000 jobs in that year alone. Although Law of Ukraine No. 2322 dated March 22, 2001, remains in effect, the SEZ "Transcarpathia" is no longer operational and enterprises still located within the zone operate under general conditions.

Based on the results of the functioning of the SEZ "Transcarpathia", it can be asserted that special economic zones have the potential for restoration in Ukraine, provided that past mistakes, new development trends and lessons from international experience are taken into account. Generally, it is quite common in international practice to have both successful and unsuccessful SEZs (Zeng, 2021).

To assess the feasibility of establishing any variation of SEZ, World Bank experts suggest a decision-making algorithm with guiding questions (Fig. 6.4).

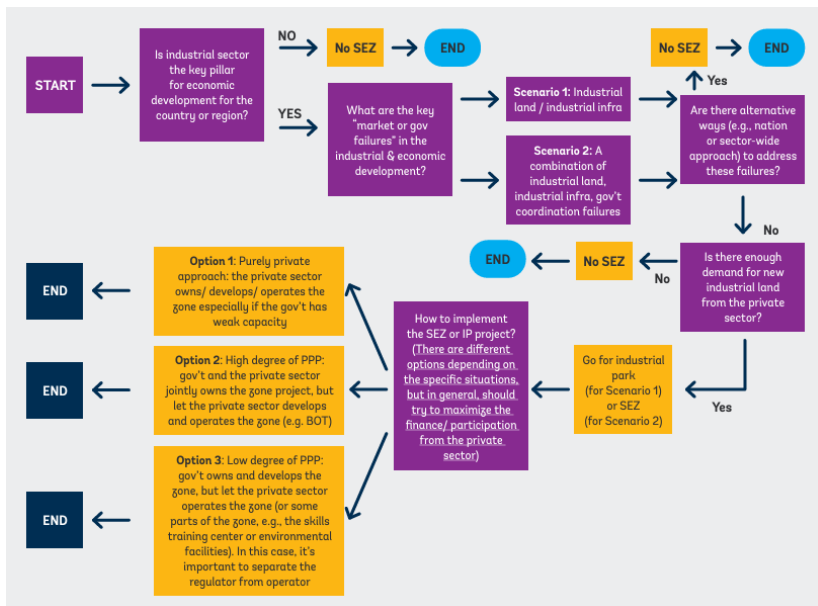


Fig. 6.4. The decision-making process for SEZ initiatives and potential approaches

Source: Zeng, 2021.

However, this algorithm appears somewhat discriminatory towards industrially weak countries, as it assumes that only countries with a strong industrial sector should consider creating SEZs. In this way, the World Bank essentially condemns industrially weak, poor countries to continued poverty by depriving them of the opportunity to develop their own industrial sectors, in which SEZs have proven highly effective. As noted by Eric Reinert, Honorary Professor at University College London's Institute for Innovation and Public Purpose, countries that focus on producing raw materials, accept their raw-material status and fail to cultivate a manufacturing industry will never make the transition from poverty to wealth. As the Bible says, they will be doomed to “hewing wood and drawing water” endlessly (Reinert, 2008).

Ukraine, unfortunately, belongs to the group of countries with a deindustrialized, primitive, raw-material-based economy. In 2021, the national industrial sector created half as much added value as in 1991 (The World Bank, 2024). In the context of the war, Ukraine's raw-material specialization has further intensified, as it has lost nearly a third of its economy due to destruction, including industrial enterprises and entire industrial cities (Mariupol, Kramatorsk, Kharkiv). The most heavily affected regions are those situated near the frontlines (Donetsk, Zaporizhzhia, Luhansk, Mykolaiv, Kharkiv and Kherson regions): the total amount of damage and losses in these areas accounts for 42% of Ukraine's overall losses. Consequently, the reconstruction needs in these regions are the highest among all types of regions—\$250.5 billion, or 51.5% of Ukraine's total reconstruction needs (Himmelfarb, 2023).

As a result, the added value generated by the industrial sector decreased to \$7.56 billion, 1.5 times less than in 2021 and 3.3 times less than in 1991 (The World Bank, 2024). Under such conditions, decisive economic measures and the most effective policy instruments are needed to overcome the resource curse and escape the grip of poverty. Furthermore, Ukraine is currently heavily reliant on international financial assistance, but this situation cannot last indefinitely. Eventually, Ukraine will have to rely primarily on its own resources and capabilities, as well as repay its debts. Without transforming its raw-material-based economy into an industrial and

innovative one, without the return of external migrants and without attracting active, talented youth from other countries and filling the economy with foreign investments, these challenges cannot be overcome. Therefore, it is crucial to swiftly implement proactive economic policies that anticipate future needs and build not a primitive economy – a raw-material appendage of the developed global world – but an efficient high-tech producer and exporter of goods and services with high added value. In this regard, special economic zones could play a pivotal role.

Compared to other countries, Ukraine is in a significantly disadvantaged position due to the ongoing military conflict. Consequently, investment incentives within national economic zones must be substantial enough to mitigate this negative factor. This could include exemptions from any taxes for new investments in the manufacturing and high-tech services for a period of 5 to 10 years, or compensation for capital expenditures for investors through tax incentives. Among all types of regions, the least attractive for foreign investors are those located near the frontlines, which have suffered the most extensive destruction of housing, infrastructure and enterprises, have the highest number of internally displaced persons and face a significant risk of escalating conflict. In these regions, the state must assume the primary financial burden and ensure maximum risk coverage for investors.

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Yuliia Mashyna

Kyiv National Economic University named after Vadym Hetman

7. ENERGY COMPONENT OF ECONOMIC SECURITY OF UKRAINE

7.1 Theoretical aspects of the study of state's economic security

The role of economic security of the state is to ensure the sustainability of the economy and protect national interests. Economic security is a prerequisite for the country's sustainable development and ensuring the population's well-being. Today, there are many approaches to defining the essence and components of economic security in the scientific literature. It is appropriate in this case to appeal to the national legislation of Ukraine, which regulates the economic security of Ukraine, gives a general and relevant definition of this concept and defines its function. According to the Constitution of Ukraine, economic security is one of the highest functions of the state (Constitution of Ukraine, 2020). In addition, economic security is a part of “The National Security Strategy of Ukraine” (National Security Strategy of Ukraine “Human Security is the Security of the Country”, 2020). According to the mentioned strategy, the “Economic security strategy of Ukraine for the period until 2025” was developed (Strategy of economic security of Ukraine for the period up to 2025, 2021). This document provides the following definition: “Economic security is a state of the economy when the basic national economic interests are achieved” (Strategy of economic security of Ukraine for the period up to 2025, 2021). The concept of economic security is important for the economic interests of the state.

Pravdyvets O.M. notes that the economic security of states can be determined as the purposeful activity of a number of state bodies (both central and local self-government), directed at “ensuring the sustainable functioning of the national economy of the state, its social and economic development and economic well-being of

citizens” (Pravdyvets, 2022).

A number of scholars researching this topic, such as Korniyenko T. O., Tretyak V. V. and Gordiyenko T. M., have pointed out that economic security is considered as an important mechanism for protecting national interests, ensuring the stability and well-being of the state in the conditions of global and domestic challenges: “[economic security] is a means of protecting the national interests of the state”. Thus, the task of the state is to develop a new economic security strategy based on scientific research and arguments as a way out of the country’s difficult economic situation (Korniyenko, 2022; Tretyak, 2010).

A more detailed schematic of the main definitions of the category “economic security” is given below (Fig. 7.1) and illustrates the multifaceted nature of this concept. Economic security involves many factors and requires a comprehensive approach in order not only to ensure and support it but also to define it in general.

It is important to note that economic security plays a key role not only in the protection of national interests but also in the availability and ability to use various instruments of influence on economic processes in order to ensure the stability and well-being of the population in the long term. So it is important to consider economic security not only as a state but also as a possibility to apply and ensure influence on certain economic aspects of society (Sak, 2013).

Thus, it can be distinguished the following main approaches to determining the economic security of the state:

- the condition of the state’s economic system, which ensures the resilience of its economic system to external and internal threats that may lead to a severe disruption of its functioning and threaten the interests of national security;

- a set of measures aimed at ensuring the sustainability and security of the national economy, reducing the risks of losing economic independence, protecting national interests and the welfare of the population.

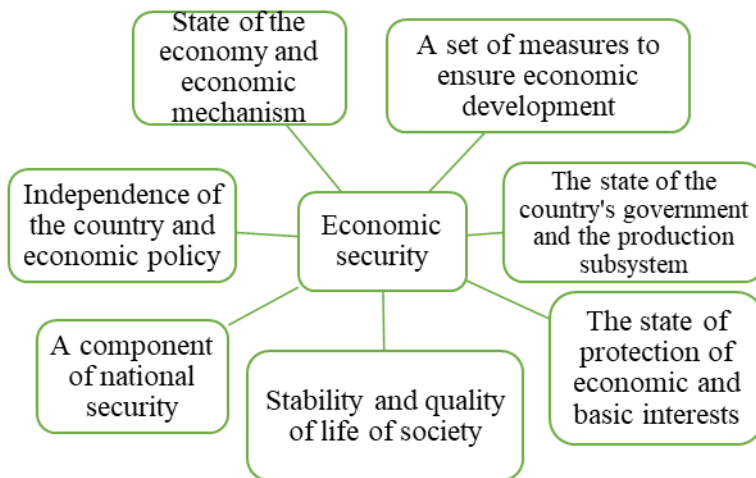


Fig. 7.1. Basic definitions of the category “economic security”
 Source: Tretyak, 2010.

Thus, this concept has many aspects, including economic, financial, political, social, environmental and other components (Pravdyvets, 2022; Korniyenko, 2022; Kotyk, 2022). The essence of economic security of the state consists in ensuring the sustainable and stable development of the national economy and the protection of the interests of the country. It means that economic security is aimed at protecting national economic interests from external and internal threats, ensuring the stability of the macroeconomic situation, preserving national resources, balancing foreign and domestic trade, supporting the competitiveness of producers and ensuring the rational use of the country’s economic potential. It is necessary to refer to the main components of the economic security of the state to understand this concept better (Fig. 7.2).

The energy security of the country as a component of its economic security is particularly important for the study. Energy security ensure the stability and security of the state’s energy system, as well as an adequate level of energy self-sufficiency and competitiveness of the economy. It means ensuring a reliable supply

of energy for the population and the economy, as well as reducing dependence on imported energy. Various measures can be carried out to achieve these goals, such as developing domestic energy production, diversifying sources of energy imports, improving energy efficiency and developing alternative energy sources (Shevchenko, 2021).

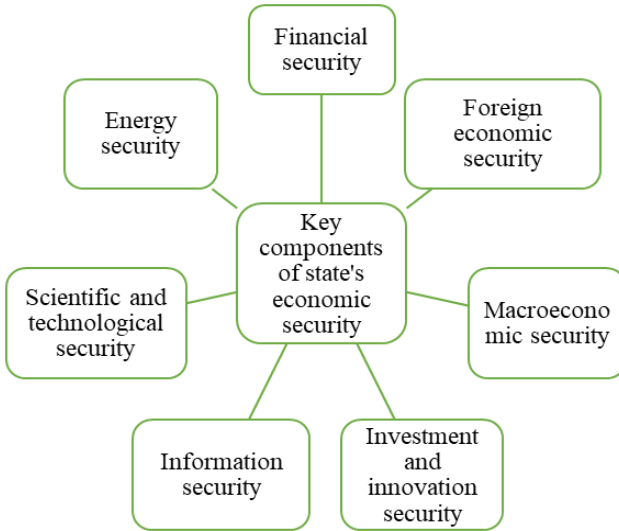


Fig. 7.2. The main components of state's economic security
 Source: Korniyenko, 2022; Hnatenko, 2021.

In recent years, the scientific and political discourse has increasingly emphasized the importance of environmental safety in the context of developing a balanced society. Environmental safety ensures the sustainable development and conservation of natural resources that provide the safety of public health and ecosystems. The state must regulate the use of natural resources, ensure compliance with environmental standards and develop technologies and practices that promote sustainable development and environmental safety to achieve environmental safety (Radchenko, 2022).

The following important component is financial security. It is

the ability of state to ensure the stability of the financial system, avoid financial crises and manipulation, maintain a stable national currency exchange rate and balance the government budget. Financial security is an important component of the state's economic security and consists in ensuring the stability of the financial system and the economy as a whole. Financial security implies maintaining a stable national currency exchange rate, developing an efficient banking system, ensuring the stability of the state budget and avoiding financial crises and manipulation. Financial security is an important factor in the state's economic sustainability and contributes to its economic development (Petreman, Dubych, 2021).

One more of the key components of the foreign economic security of the state is to ensure the sustainability of the country's external economic relations, reduce dependence on external markets and ensure the competitiveness of national producers in the international market. External economic security also includes protection against the negative impact of external economic competition and national discrimination at the national level, as well as ensuring stability and reliability of external economic relations in a globalized world economy. In particular, the components of foreign economic security include control over the movement of capital, trade operations and international investments, the development of economic sanctions and mechanisms for foreign economic relations regulation (Kotyk, 2022).

Macroeconomic security is closely related to the previously discussed component of economic security. This concept is understood as the ability of the state to ensure the sustainability of the national economy, avoid inflation, reduce the levels of GDP and unemployment, balance budget expenditures and increase state revenues. Ensuring price stability, managing monetary policy, regulating the exchange rate, balancing budgetary and fiscal policies, reducing unemployment and increasing citizens' incomes may also be considered components of macroeconomic security. In addition, macroeconomic security involves the reduction of risks associated with the external economy, such as import dependence, changes in external demand and competition in the international market (Hnatenko, 2021).

Investment and innovation security is also necessary for the development of society. It includes attracting investments for economic development and stimulating innovative projects that increase the competitiveness and development of the state's economy. Investment and innovation security includes measures aimed at creating a favorable investment climate in the country, attracting foreign investment, protecting investors' rights and developing national innovation potential and innovation infrastructure. The effective mechanisms of state regulation and support of entrepreneurial activity (in particular, stimulation of the innovative companies' activities, research conducting and development of high-tech industries) are necessary to ensure investment and innovation security (Guliaieva, Vavdiichyk, 2018).

In the modern world, the existence of a strong state is impossible without ensuring information security, which includes ensuring the protection of the information space of the state from external and internal threats that can damage the national economy and threaten national security. Information security also includes protecting against cyber-attacks, thefts and illegal access to confidential information, as well as ensuring the secure storage, transmission and processing of information. The components of information security include the protection of state and commercial secrets, the protection of citizens' personal data and protection from misinformation and other forms of information manipulation. Information security also can include the development of information and communication infrastructure and ensure the access to it for all segments of the population (Hnatenko, 2021; Zalyevska, Udrenas, 2022).

The following essential aspect is scientific and technological security. It is one of the components of the state's economic security related to the level of development of science and technology, their use in production and the protection of intellectual property. This component is especially important for countries functioning in high-tech industries and competing in the international market. Within the framework of scientific and technological security, the state ensures the development of scientific research and scientific and technical base, creates the conditions for commercialization of scientific

developments, promotes the creation of innovative enterprises and start-ups and provides intellectual property protection (Romanovska, Kozachenko, Pogorelov, 2022; Harkava, 2022).

One more component of the state's economic security is social security, which includes ensuring living standards, safety and health of the population, as well as social stability in the country. It includes providing the population with adequate levels of social services and social protection such as health protection, education, housing, pensions, assistance for low-income social groups and others. In addition, social security also includes ensuring the stability and security of the internal social environment, as well as reducing the risk of social conflicts and inequalities in society. If social security is not ensured, the problems with the economic stability of the country may arise, including a drop in demand for goods and services, an increase in unemployment and an increase in social tension in society (Harkava, 2022).

Demographic security is the provision of stable development of the population of the state, which includes maintaining the birth rate and preventing depopulation due to the migration, high mortality or low birth rate. Demographic security also includes ensuring adequate health care, education and social protection for all groups of population. In order to ensure demographic security, it is necessary to solve problems related to population health, demographic processes, national migration and other factors that affect the development and the preservation of the population of the state (Gnatenko, 2021).

Food security is the provision of the population of a state with access to an adequate level of food products, including their quality, quantity and variety. Food security also includes ensuring the sustainability and stability of food production and supply, as well as protection from the negative impacts of climate change, natural disasters and other threats to national productivity and food security (Gnatenko, 2021).

Industrial safety is ensuring safe and sustainable production processes that provide high product quality and the security of workers, consumers and the environment. The state must regulate production processes and monitor their compliance with quality and

safety standards, as well as provide financial and technical support for the development and implementation of new technologies to achieve industrial safety, t (Petreman, Dubych, 2021).

A state's economic security criterion is the degree of compliance of its economic policy with an effective national strategy and the degree of confidence in it both within the state and by international organizations. The non-compliance of economic policy with an effective national strategy, as well as the loss of confidence in it inside or outside the state, is a serious signal to the authorities that notes a threat to the state's security. Taking into account the primacy of the economy, the consistency of the economic course of an effective national strategy is the most important (Gnatenko, 2021).

The economic security of the state provides the protection of the national market from unfair competition, the development of an economy that is competitive in the international market, the preservation of the domestic market that ensures meeting the needs of the population and the reduction of dependence on external sources of funding and resources. Moreover, the economic security of a state involves measures to protect economic information from unauthorized access, leakage or its use by malicious actors or competitors. An important element of economic security is also the protection of intellectual property, which ensures the stimulation of innovative development and increase in competitiveness of the national economy.

Thus, the main goal of the development of economic security of the state is to ensure sustainable economic growth and strengthening of the national economy, which ensures an adequate standard of living for the population, security of national interests and preservation of the sovereignty of the state (Korniyenko, 2022). Economic security is a moving element of the economic system, that constantly adapts to the changing requirements and conditions of the modern world and responds to the challenges and opportunities of the modern economy.

Thanks to its dynamic nature, economic security ensures a state's ability to adapt to various external and internal challenges, including global economic fluctuations, political instability or technological changes. (Golikov, 2014). Thus, economic security is

an important factor contributing to the stability and development of any state, stabilizing its economy, maintaining the level of well-being of the population and ensuring the country's competitiveness on the world stage.

7.2 Role of energy policy during the formation of state's economic security

Energy policy plays a responsible and significant role in the formation of the economic security of any state. As Bobrov Ye. A. points out, the study of economic security issues, particularly energy security, is of great importance for ensuring each country's national security of especially for those, that do not have a sufficient supply of energy resources (Bobrov, 2012). It emphasizes the significance and importance of energy security for each country. Both for those, which have their own resources to meet the needs of society and for those facing the problem of insufficient energy resources.

In the modern world, it is difficult to imagine an economically stable and developed state without a reliable and carefully thought-out energy policy. After all, it is the competent formation and high-quality implementation of such a policy, based on a deep understanding of existing problems and effective management plays a key role in ensuring national interests, stability and further growth of the country's economy. The problem of energy security has long since become a global issue. Ensuring energy security is becoming an important priority issue for countries around the world, since ensuring a stable supply of energy resources plays a decisive role in the functioning of the economy of each state (Moskalyuk, 2019).

While emphasizing the significance of these problems, it should be noted that solving them requires common international efforts. It involves investing in research and innovation to implement more transparent, more efficient technologies that will provide access to energy while minimizing the negative impact on the environment and promoting sustainable development on the planet. According to the International Energy Agency (IEA), the sustainable development of humanity in the future will depend on how quickly the global

community can solve two key problems: ensuring reliable energy supply routes and making a rapid transition to more efficient and environmentally friendly energy supply systems (Moskalyuk, 2019; World Energy Outlook, 2018).

It is impossible to overestimate the importance of the energy policy and energy industry as a whole for ensuring economic security, which is an integral part of the functioning of society. Doctor of Technical Sciences Denysyuk S.P. states that the growth of energy productivity is one of the conditions for development of modern society. Global experience shows that countries have achieved rapid growth in international competitiveness only when energy efficiency and the development of intelligent energy systems have become the basis of state policy (Denysyuk, 2013). Thus, the emphasis is placed on the need to increase energy productivity for society, which also emphasizes the significant role of energy policy in shaping the main directions of development in order to achieve a high level of international competitiveness and to obtain significant benefits for the economy, environment and stability of society as a whole.

The term “energy efficiency of the economy” should be considered as a qualitative aspect of the economy, ensuring rational and efficient use of primary energy resources, taking into account the current level of economic, technological and cultural progress of society (Mitrakhovych, Gerasymchuk, 2009). Such definition of “energy efficiency” emphasizes the importance of the qualitative state of the economy, when resources are used rationally and efficiently. That is why a proper energy policy that meets the needs of society and aims at sustainable development plays a significant role. Focus on improving energy efficiency defines progressive directions of innovative development.

Energy efficiency is an important indicator of the quality of the functioning of the country’s economic system, reflecting the harmonious interaction between business entities. They should contribute to improving the energy efficiency of production, since it directly affects the profitability and rate of return of their business.

Thus, the activities of, for example, individual enterprises, which represent important components of the country’s economic

system and contribute to strengthening the state's economic security, depend on the energy policy implemented by the state. Both the state and the population are interested in increasing energy efficiency. Increasing the efficiency of energy resources in the country leads to an increase in the tax base and a reduction in government expenditures.

For citizens, increasing energy efficiency means the opportunity to increase income levels and reduce costs for purchasing energy services. In general, for society, the effective implementation of energy policy aimed at increasing energy efficiency is an opportunity to approach the level of sustainable development (Kytskai, 2013). Energy policy plays a key role in influencing all elements of society — from the state to individual citizens. Energy policy influences the work of enterprises, forming the conditions under which they are functioning, which, in turn, plays a significant role in the country's economic stability.

In the context of the relationship between taxes and energy policy, it should be noted that the share of preferential taxation in the state is adjusted according to the economic benefit, the amount of savings of raw materials and the impact of program measures on the energy consumption of the produced GDP (Tsapko-Piddubna, 2009). It means that the government can use preferential taxation as a tool to stimulate energy efficiency in the country. Depending on how effectively the programs reduce the energy intensity of GDP (i.e., the amount of energy used to produce a unit of GDP) and how they affect raw material savings, the share of the tax credit can be adjusted. Encouraging energy efficiency can lead to decrease in energy costs, reduction of emissions and increase in overall economic efficiency, which has a positive impact on the country's economic security. The government can provide tax exemption to companies that implement energy-efficient technologies or practices to encourage them to take such measures.

Energy policy can also reduce the risks of an energy crisis and ensure sustainable economic development while using in order to reduce import dependence of energy resources on other countries, for example, through the development of alternative energy sources. According to Antonova L.V., one of the main components of the EU

energy policy is the diversification of energy resource imports and the creation of new infrastructure for the supply of liquefied gas (Antonova, 2019). It is an example of the extreme importance of pursuing an energy policy that meets the needs of the EU member states, since the failure to implement such a policy or its insufficient implementation could lead to severe economic consequences and a violation of economic and, accordingly, national security. A disruption or significant reduction in supplies can cause an energy crisis, which can negatively affect the entire economy. The case study of the European Union shows how energy policy is important for economic security. The EU is actively working to implement an energy policy to ensure its member states' economic security.

As V.V. Sabadash notes, a decisive factor in the system of national economic security is ensuring energy security. The latest technological structures (primarily the third and fourth), which determine a certain level of socioeconomic development of the national economy, require the massive use of material, natural and energy resources in production and consumption models. Resource factors play a decisive role in the creation of an integrated security system that meets the socioeconomic development level of the national economy – foremost, the availability and efficiency of the use of natural and energy resources (Sabadash, 2011).

Therefore, it can be concluded that ensuring energy security is a critical factor for the national economic security system and the stable socioeconomic development of the nation. Energy policy, aimed at providing society with the necessary natural and energy resources, plays a crucial role in forming a comprehensive security system adequate to the current level of development of the country. The importance of energy policy and the energy sector relates to various aspects of the stability of society, including its economic security. An effective energy policy helps ensure the reliability of energy supply and stimulate the development of the national economy.

In addition, energy policy aimed at stimulating the use of renewable energy sources in the modern world has become a powerful catalyst for transforming the energy sector. It has not only given impetus to the active study and development of alternative

energy sources but has also contributed to the creation of conditions for the development of new areas in energy, particularly wind and solar. Progress in the creation, implementation and operation of wind and solar power plants has given rise to a dynamic new economic sector. With its emergence, new organized groups of economic interests have appeared (Benz, Czada, 2019). The development of a new economic sector creates new jobs, promotes innovation and technological progress, which also strengthens economic security. At the same time, the formation of new economic interest groups stimulates the development of the domestic market, enhancing economic stability.

To sum up, it can be noted that the state energy policy plays a significant role in ensuring economic security while serving as an essential tool in the hands of the state to protect economic interests, maintain stability of the domestic market and increase investment.

7.3 Modern challenges and problems of energy policy of Ukraine

The energy market of Ukraine is an integral part of the global energy market. It is critical to ensuring the country's vital activity and the development of its economy. Like other countries, Ukraine depends on the outside world for energy issues. At the same time, Ukraine has its own rich energy resources, which enable it not only to meet its own needs but also to export them abroad. In this subsection, we will consider the features of the energy market of Ukraine, its structure and functioning, as well as the influence of external factors on the country's energy security.

Ukraine has a powerful and diversified energy sector and has reliable energy transportation systems. The country is among the top 10 countries in Europe in terms of installed power generation capacity and among the top 3 gas producers. It also has the largest underground gas storage facilities in Europe. Ukraine cares about the environment and has a high share of carbon-neutral generation, which is about 70% of the electricity produced. Despite the damage caused by the Russian invasion, the Ukrainian energy sector continues to develop and remains powerful in Europe.

Ukraine is successfully reforming its energy sector in compliance with the EU legislation. From 2019 to 2021, the disconnection of gas transmission network operators and transmission systems was successfully completed, as evidenced by their certification. Gas and electricity markets have been reformed and corporate governance reform is underway in state-owned energy companies.

NEC Ukrenergo, as the operator of the transmission system of Ukraine, has been taking measures for the synchronization with ENTSO-E since 2017, after signing the Agreement on the conditions of future unification. The energy systems of Ukraine and Moldova have successfully passed the testing of power units and have been fully synchronized with the continental European ENTSO-E power grid ahead of schedule. Studies on the static and dynamic stability of energy systems have proven the technical feasibility of synchronization.

These and other reforms have led to positive changes in some sectors of the economy. For example, compared to 2014, Ukraine is no longer dependent on Russian gas but remains partially or wholly dependent on fuel imports.

Before the invasion in February 2022, Ukraine was ensuring its coal needs for 75%, with the rest imported from various sources on competitive terms. Despite the blockade by Russia, the 2021/2022 heating season was stable and without shutdowns for consumers, thanks to the diversification of coal supply sources. There were 701 thousand tons of coal in warehouses as of 23.02.2022, which is twice as much as on the same date in 2021. Moreover, the measures were implemented to save coal by increasing domestic coal production and using other fuel types, such as nuclear power plants and renewable energy sources. In 2021, 1.2 GW of new renewable energy capacity was built, which allowed for the reduction of the need for coal (The National Council for the Recovery of Ukraine from the Consequences of the War. Draft Ukraine Recovery Plan. Materials of the “Energy security” working group, 2022).

Ukraine has a variety of energy sources, with nuclear energy playing an important role (Fig. 7.3). Fossil fuels remain the largest source of primary energy in Ukraine, with coal and natural gas

accounting for the largest share.

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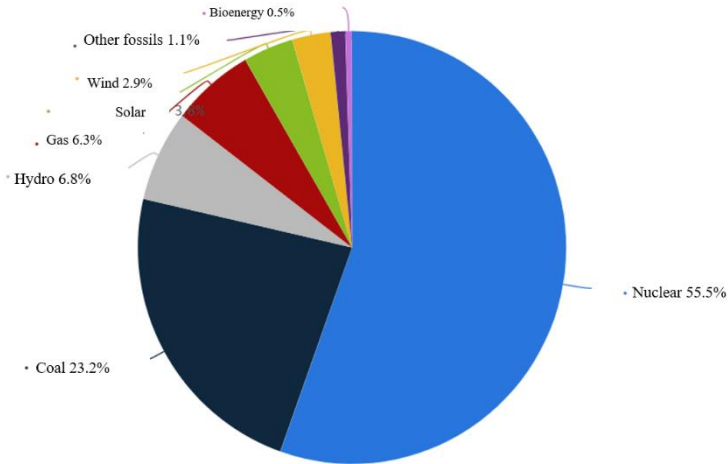


Fig. 7.3. Distribution of electricity production in Ukraine in 2021 by sources

Source: compiled by author based on (Power production breakdown in Ukraine, 2021).

Before the war, nuclear power typically produced over half of Ukraine's electricity. The generation structure fluctuated as Ukraine has endured large-scale, targeted Russian attacks on its energy infrastructure that have knocked out about 50 percent of the country's generating capacity. Ukraine's Zaporizhzhia Nuclear Power Plant is not currently functioning. All six reactors are in shutdown mode, as the facility remains occupied by Russian troops and at risk of shelling and damage.

Ukraine has the highest technical potential of renewable energy sources among other countries in South-Eastern Europe – 874 GW⁴, including solar – 83 GW, onshore wind – 438 GW, offshore –

250 GW (Fig. 7.4). Due to the high potential of renewable energy sources and effective support mechanisms, the Ukrainian renewable energy sector is developing rapidly, the share of renewable energy sources in electricity production increased from 1.8% in 2018 to 8.2% in 2021.

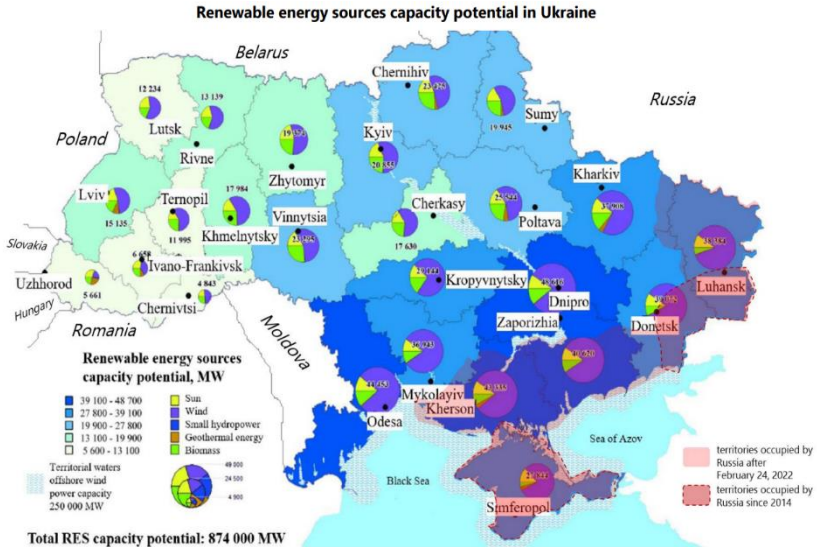


Fig. 7.4. Renewable energy sources potential in Ukraine

Source: The National Council for the Recovery of Ukraine from the Consequences of the War. Draft Ukraine Recovery Plan. Materials of the “Energy security” working group, 2022

The distribution of shares by renewable energy sources is shown in Fig. 7.5. At the beginning of 2022, the total installed capacity of renewable energy sources (all connected to the grid) reached 9.5 GW (excluding 0.6 GW of renewable energy capacity located in the territories temporarily occupied by Russia before February 24, 2022). From 2009 to 2021, about \$12 billion was invested in the renewable energy sector of Ukraine (Ukrainian energy sector evaluation and damage assessment – II, 2022).

Natural gas plays a relatively minor role in electricity generation. Natural gas accounts for only 7 percent of Ukraine’s

electricity production, but that share could rise after 2030 to support intermittent renewable energy and compensate for the decline in coal production. Energy efficiency will be a crucial area of focus after the war to reduce household gas consumption.

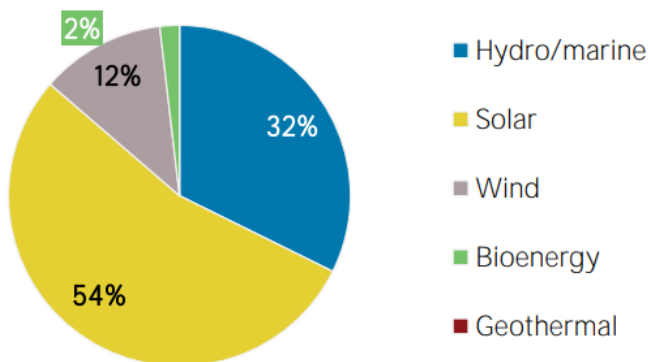


Fig. 7.5. Renewable energy sources capacity in 2021
Source: *Energy Profile: Ukraine, 2023*

Before the full-scale invasion, Ukraine covered 67% of its own gas needs, with the rest imported from the EU to a diversified base of suppliers. Ukraine’s energy security is significantly enhanced by large underground gas storage facilities. As of 23.02.2022, these storage facilities held more than 10 billion cubic meters of gas, which provided enough fuel for the domestic market until the end of the heating season, even in absence of imports. The operator of the gas transmission system of Ukraine was able to provide sufficient capacity for gas import from the European Union.

At the beginning of the invasion, Ukraine was largely dependent on imports of oil products from Russia and Belarus, which accounted for the largest imports. Ukraine provided its own resources by only 30%.

A third of Ukraine’s energy capacity is located in territories currently occupied by Russian troops. Some infrastructure facilities in the occupied territories are still operating in the Ukrainian energy system, while others are disconnected from the system, damaged, or

outside the control of Ukraine. About 4% of the generating capacity was destroyed during the fighting (Fig. 7.6).

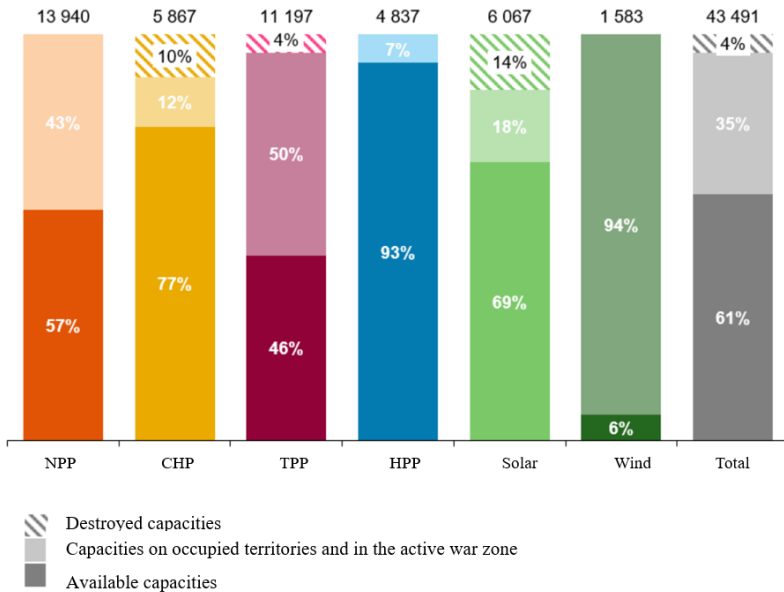


Fig. 7.6. Distribution of operating capacity of electrical power generation facilities, MW

Source: *The National Council for the Recovery of Ukraine from the Consequences of the War. Draft Ukraine Recovery Plan. Materials of the “Energy security” working group, 2022*

The Zaporizhzhya Nuclear Power Plant has effective safety systems that undergo regular stress tests and upgrades. However, there is a possibility that the Russian occupation of the power plant could lead to a nuclear disaster. This nuclear power plant is under constant pressure from the Russian occupiers but continues to operate in the Ukrainian energy system. Its production capacity is 43% of the total capacity of all nuclear power plants in Ukraine.

Overall, over 50 percent of thermal generation, 30 percent of solar generation and 90 percent of wind generation assets either have

been destroyed or are under the Russian occupation. In addition, gas production fell by 10-12% during the full-scale invasion.

Russian aggression has significantly reduced energy consumption in Ukraine, as many large enterprises that were the main consumers of electricity and gas were destroyed and millions of civilians migrated abroad.

State-owned Energoatom reports about at least \$131 million in net losses in the first half of 2022, compared with about \$30 million in net income in the first half of 2021. Electricity sales fell by 17.44% year on year (Roman Nitsovych, 2022).

To restore the energy sector in the long term, Ukraine needs to remove price controls and temporary restrictions on markets to attract investment.

Therefore, when developing a national energy strategy, Ukraine needs to consider how the consumption structure has changed or will change due to the mass substitution of scarce resources, as well as the projected resource needs of various industries.

Some sectors of the economy, especially cargo transportation, are expected to switch to electricity as a primary resource.

Ukraine's energy intensity is the primary "resource" for optimizing its economy. This indicator per unit of GDP is 3-4 times higher in Ukraine than in the leading Western countries. Ukraine needs to build its energy system in such a way as to ensure decarbonization and maximum efficiency of energy consumption.

The future energy system could differ from the current one, with a significant expansion of low-cost renewable energy sources, a more innovative and much more flexible electrical grid and a significant increase in the number of vehicles and other products and processes running on electricity.

Digitalization, decentralization and electrification, supported by innovative policy frameworks and market tools, are prepared to create new business models, change consumer behavior and radically transform established systems.

As stated in the Paris Agreement climate goals, the urgent need to reduce greenhouse gas emissions requires deep decarbonization of the energy sector, which will require a

fundamentally different approach to previous strategies for stabilizing or halving emissions. Developing and planning long-term energy and climate policies cause far more complex challenges than before. More than ever, policymakers and investors must make strategic, forward-looking energy decisions that take into account new trends and uncertainties in technologies, markets and policies.

The International Energy Agency (IEA) proposed three main scenarios for the development of the global energy market (Table 7.1).

Table 7.1. Main scenarios for the development of the global energy market

Title	The Net Zero Emissions by 2050 Scenario	Announced Pledges Scenario (APS)	Stated Policies Scenario
Definition	Scenario that determines a pathway for the global energy sector to achieve net zero CO ₂ emissions by 2050.	Scenario that provide all climate pledges made by governments worldwide, including Nationally Determined Contributions (NDCs) and long-term net zero targets, as well as targets for electricity access and clean cooking, are met in full and on time.	A scenario reflecting current policy settings based on an assessment of specific policies in place as well as those announced by governments around the world, sector-by-sector and country-by-country.

Source: compiled by author based on Understanding GEC Model scenarios, 2023

Therefore, the assessment should begin with the first of the proposed scenarios. — Net Zero Emissions by 2050 Scenario (NZE).

This scenario meets key energy-related United Nations (UN) Sustainable Development Goals, in particular by achieving universal energy access by 2030 and major improvements in air quality.

According to this scenario, all end-use sectors will achieve by 2050 a reduction in CO₂ emissions of more than 90% compared to current levels (Fig. 7.7). These and the net residual emissions in other sectors are offset by removing carbon dioxide from the atmosphere through bioenergy with carbon capture and storage during electricity generation and biofuel production, as well as through direct air capture and storage.

Emissions by sectors

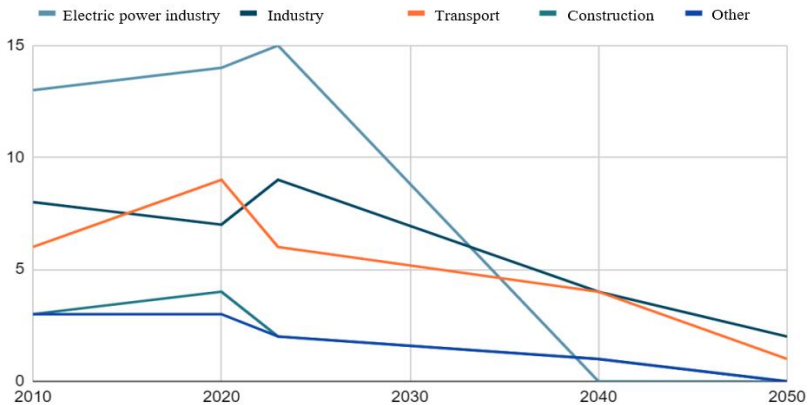


Fig. 7.7. Gross and net CO₂ emissions in the NZE scenario, 2010-2050.

Source: compiled by author based on International Energy Agency (IEA), 2022

In a net-zero emissions scenario, the global energy mix undergoes a profound transformation as low-emission sources increase rapidly and displace unabated sources in the energy sector. Traditional use of biomass is being phased out as energy access targets are met. Among low-emission sources, modern bioenergy and solar power will increase by 2030 (Fig. 7.8).

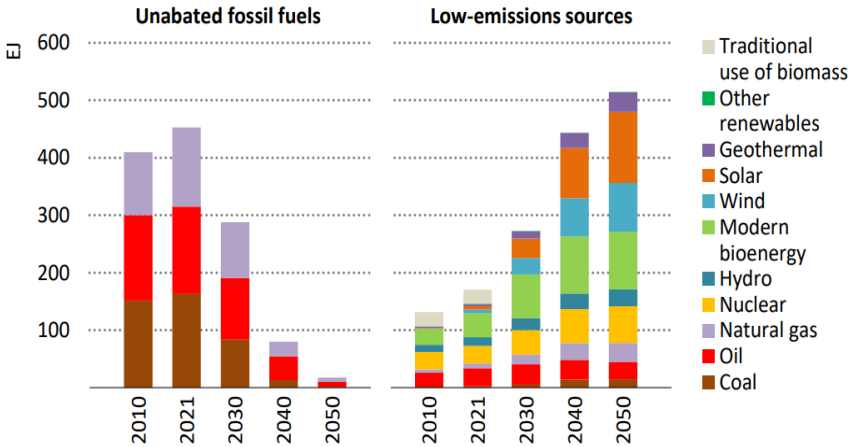


Fig. 7.8. Total energy supply from fossil fuels and low emission sources in the NZE scenario, 2010-2050 pp.

Source: International Energy Agency (IEA), 2022

Thanks to electrification, energy efficiency and behavioral changes, the total energy supply will decrease by 10% from 2021 to 2030, even if the global economy grows by nearly a third. The annual rate of increase in energy intensity nearly triples when it rises to more than 4% per year. Supply from non-exhaustible sources declines by almost a third, with zero-emission coal volumes falling by almost half and natural gas by more than a quarter by 2030. It stands in contrast to the net-zero emissions scenario in the World Energy Outlook 2021, where natural gas held most of the global energy mix for somewhat longer. This change reflects heightened energy security concerns around natural gas, caused by Russia's invasion of Ukraine.

The Net Zero Emissions by 2050 Scenario is an ambitious and very important scenario for reducing humanity's impact on climate change and the challenges associated with air pollution. Evaluating this scenario by the criteria of impact on climate change and human health, economic efficiency and social impacts, it can be concluded as follows:

Impact on climate change and human health: The implementation of this scenario can significantly reduce greenhouse

gas emissions and air pollution, which can have a positive impact on climate change and human health. Reducing greenhouse gas emissions will help to reduce global warming and the risks associated with climate change, such as droughts, floods and other negative phenomena. In addition, reducing air pollution can have a positive impact on human health and reduce health care costs.

Economic efficiency: The scenario may require significant costs and efforts to achieve net-zero carbon emissions. However, in the long term, it could lead to significant economic benefits, such as lower energy costs, increased investment in new energy technologies and the development of new markets.

Social consequences: The implementation of this scenario could have significant social impacts, as it could affect jobs in specific sectors, such as oil, coal and gas energy. However, this scenario could create new opportunities for developing a green economy and new jobs related to the development of renewable energy and innovative technologies.

Thus, the Net Zero Emissions by 2050 Scenario is an ambitious and important scenario for reducing humanity's impact on climate change and air pollution. Its implementation can have a positive impact on climate change and human health and can lead to new opportunities and economic benefits in the long term. However, its implementation requires significant efforts and costs and it can have social consequences for individual economic sectors. However, this scenario can be a key tool for preserving nature and creating a sustainable and healthy economy.

The Announced Pledges Scenario (APS), introduced in 2021, illustrates the extent to which announced ambitions and targets can deliver the emission reductions needed to achieve net zero emissions by 2050. In the APS, countries fully meet their national targets by 2030 and by 2050 and the outlook for exporters of fossil fuels and low-emission fuels such as hydrogen is shaped by what full implementation of all targets means for global demand. This year, for the first time, the APS expects that all country-level targets for access to electricity and clean cooking are met on time and in full (Fig. 7.9).

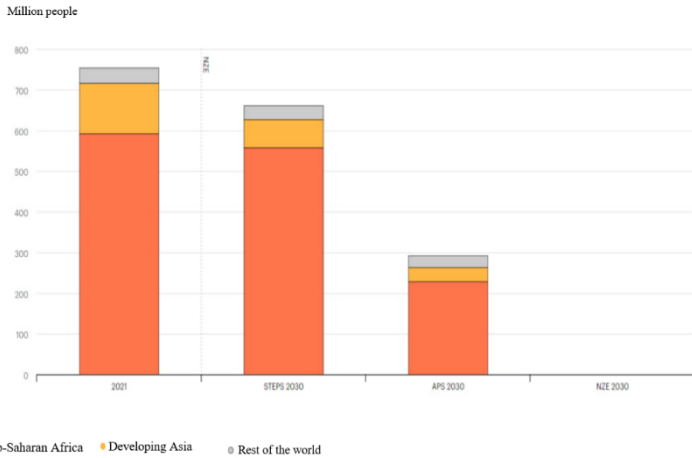


Fig. 7.9. Number of people without access to electricity in the scenario, 2021-2030

Source: *Understanding GEC Modelscenarios, 2023*

On the one hand, APS could help reduce humanity’s impact on climate change and air pollution, which would improve human health and preserve the environment. On the other hand, some experts point out that this scenario may not be enough to achieve the goal of reducing humanity’s impact on climate change and its impact may not be enough to provide sufficient protection against climate change.

It also should be noted that the implementation of this scenario may have economic and social consequences for specific sectors of the economy. For example, some companies specializing in coal and oil production may face difficulties in transitioning to green energy.

Thus, APS may become an important step in reducing humanity’s impact on climate change, but its impact may not be sufficient to achieve the goal of reducing carbon emissions to zero.

The Stated Policies Scenario (STEPS) is the last scenario we will study. In this scenario, global energy demand growth by about 1% per year by 2030 is covered almost entirely by renewables. Countries with developing markets and developing economies, such

as India, see growth in a wide range of fuels and technologies. In contrast, the only source of growth in developed economies by 2030 is low emissions.

The cost advantages of mature clean energy technologies and new prospects like low-emission hydrogen are being reinforced by the Inflation Reduction Act in the United States, a significant push for clean energy in Europe and other important new policies. The result is a turbocharged global, clean, emerging energy economy.

STEPS is the first World Energy Outlook scenario based on prevailing policy settings that assumes an eventual peak in global fossil fuel demand. Coal demand reaches its peak in the next few years, fossil gas demand reaches plateaus by the end of the decade and oil demand sets its peaks in the mid-2030s before falling slightly. 80% is the level that has remained constant for decades for fossil fuels, but its share in the global energy mix will fall to less than 75% by 2030 and just above 60% by mid-century. According to the Advanced Pledge Scenario (APS), the drive to fully meet climate commitments would see demand for all fossil fuels decline by 2030.

While assessing STEPS using the same criteria used to assess Net Zero Emissions by 2050 Scenario and Announced Pledges Scenario, we can note the following:

➤ Impact on climate change and human health:

STEPS provides a reduction in greenhouse gas emissions by 2030, but at a level that will still increase global temperatures by more than 2°C compared to the era before the Industrial Revolution. It could significantly impact climate change and human health, in particular, an increase in the number of extreme weather events and harmful effects on the air people breathe.

➤ Economic efficiency:

STEPS may have a more effective economic impact comparing to the Net Zero Emissions by 2050 Scenario, since it may reduce the need for significant spending on zero-carbon technologies and other costly measures. However, most countries may face difficulties in providing the necessary investments to implement the stated measures.

➤ Social consequences:

STEPS may have a less significant impact on social

consequences than the Net Zero Emissions by 2050 Scenario because it does not require such drastic changes in the energy sector.

Overall, all three scenarios proposed by the International Energy Agency (IEA) have their advantages and disadvantages in terms of impact on climate change, economic efficiency and social consequences.

The Net Zero Emissions by 2050 Scenario may be very ambitious and difficult to implement, but it could help avoid the worst impacts of climate change and improve human health. However, its implementation may require significant costs and efforts.

The Announced Pledges Scenario is less ambitious and may bring insufficient results in the fight against climate change. However, it is based on existing policies and programs that could achieve the goals in a cost-effective way.

The Stated Policies Scenario has limitations as it does not provide a complete transition to renewable energy and achieving net-zero carbon emissions, which could lead to further increases in greenhouse gas emissions and climate change. However, it may be less expensive and less complicated to implement.

Thus, the choice of scenario depends on the importance of a particular aspect, such as human health, economic efficiency or achieving zero carbon emissions and must be carefully justified and implemented with the participation of all stakeholders.

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8. PUBLIC-PRIVATE PARTNERSHIP AS A TOOL FOR INFRASTRUCTURE DEVELOPMENT IN TERRITORIAL COMMUNITIES IN THE CONTEXT OF POST-WAR RECOVERY

8.1 Infrastructure and service projects for territorial community recovery based on public-private partnership

Infrastructure and service projects for the recovery of territorial communities based on public-private partnerships (PPP) focus on the development of critical facilities and services that support sustainable regional development and improve the quality of life for the population. The inclusion of capital and innovative solutions from the private sector allows for more efficient restoration and modernization of infrastructure, including roads, healthcare and educational institutions, water supply and sewage systems, as well as housing and utility facilities (Ahmadi, L., Arbabi, H., Sobhiyah, M.H. et al., 2024). These projects may also encompass digital services, public transport development, and energy systems focused on increasing energy efficiency and the use of renewable energy sources (Kuzior A., Liashenko V., Petrova I., Serdiuk O., 2023). Implementing PPP in this context fosters the engagement of private sector expertise and accelerates recovery processes, which is critical in post-war reconstruction.

The role of public-private partnership as a tool for attracting private investment into infrastructure and service projects is becoming increasingly significant amid growing infrastructure needs. According to the Global Infrastructure Hub (Global Infrastructure Outlook – A G20 INITIATIVE, 2024), global infrastructure investments reached \$2.9 trillion USD in 2024, with a projection of \$3.8 trillion USD by 2040 (Fig. 8.1). In Ukraine, where a substantial portion of infrastructure has been destroyed by war, the need for investment in recovery is critically increasing, and PPPs can serve as a vital tool for attracting capital for this purpose.

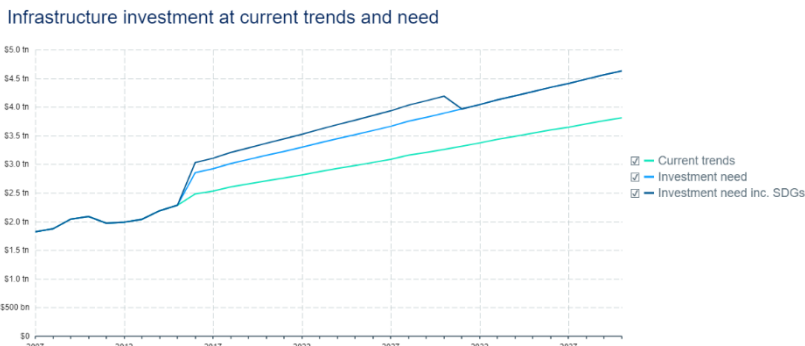


Fig. 8.1. Infrastructure Investments at Current Trends and Needs

Source: Global Infrastructure Outlook – A G20 INITIATIVE, 2024

The successful implementation of infrastructure projects based on PPP requires improvements in institutional support. Despite the accumulated experience with PPP projects in Ukraine, the number of successfully completed initiatives remains limited. According to the World Bank (Private Participation in Infrastructure (PPI) – World Bank Group, 2023), only 84 PPP projects were implemented in Ukraine from 1990 to 2023 across sectors such as energy, information and communication technology, natural gas, ports, and water management and sewage (Fig. 8.2).

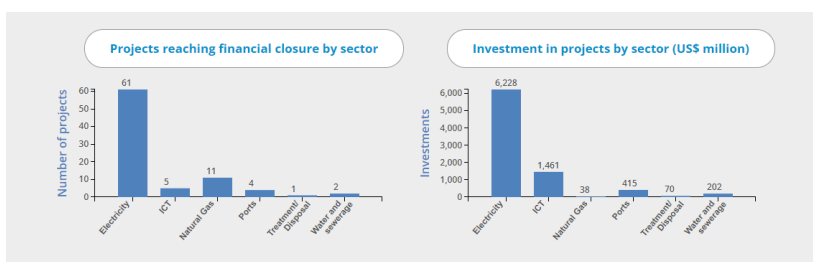


Fig. 8.2. Number and Value of Public-Private Partnership Projects by Sector, According to World Bank Data

Source: Private Participation in Infrastructure (PPI) – World Bank Group, 2023

Meanwhile, national statistics indicate a higher number of agreements. The practice of PPP project implementation in Ukraine over the past 10–15 years has revealed a number of serious issues that have negatively affected the effectiveness of this tool (Petrova I.P., 2024a). According to the Ministry of Economy of Ukraine (Ministry of Economy of Ukraine, 2024), although the number of PPP contracts continues to grow, challenges in actual project implementation remain unresolved. Statistics indicate that from 2018 to 2023, the number of PPP contracts increased from 189 to 198, yet the number of implemented projects decreased significantly, reaching its lowest point in 2022 due to war-related events (Table 8.1).

Table 8.1. Number of Public-Private Partnership Contracts in Ukraine from 2018 to 2023

Year	Number of PPP Contracts	Ongoing	Not Implemented	Not Executed	Terminated	Expired	Suspended due to War
2018	189	58	131	113	14	4	0
2019	187	52	135	113	18	4	0
2020	192	39	153	116	31	6	0
2021	193	31	162	119	43	-	0
2022	193	18	175	116	46	-	13
2023	198	22	176	115	51	-	10

Source: Ministry of Economy of Ukraine, 2024

The increase in non-implemented projects from 131 in 2018 to 176 in 2023 highlights significant issues in PPP project management and the inefficiency of institutional support. The number of non-executed projects remains high (around 115), indicating difficulties in fulfilling obligations by private partners or inadequate oversight by the state. The rise in terminated contracts, from 14 in 2018 to 51 in 2023, reflects an increase in conflicts and unmet conditions, likely due to ineffective regulation, insufficient oversight, and legal uncertainty. The low number of contracts with expired terms (from 4

in 2018 to 6 in 2020) suggests that many projects have either not reached completion or were not implemented. The suspension of projects due to war events from 2022 (13 in 2022, 10 in 2023) illustrates the adverse impact of the war on project implementation, further complicating the situation and increasing risks for investors.

To overcome these challenges, a comprehensive approach to PPP regulation is necessary, including effective project monitoring, ensuring transparency in procedures, and involving local communities in the planning and implementation of projects. The successful implementation of service and infrastructure projects based on PPP can provide substantial economic and social benefits, contributing to the recovery and development of Ukraine's territorial communities, especially in the context of post-war recovery.

In the context of recovery and development of territorial communities through infrastructure and service projects based on public-private partnership, it is essential to consider both socio-economic and environmental aspects (Petrova I.P., 2023). Integrating environmental standards into such projects will not only promote sustainable development but also attract foreign investors increasingly focused on projects with high compliance with ESG (Environmental, Social, and Governance) principles. For example, one of the priority areas could be the modernization of water supply and sewage systems. Many Ukrainian communities face issues related to outdated infrastructure in need of major repairs or complete replacement. PPP projects can attract private investment to introduce modern water purification technologies, improving water supply quality and addressing environmental issues like water resource pollution.

Furthermore, the development of alternative energy sources, particularly bioenergy and solar energy, can be successfully implemented in communities based on PPP. Given Ukraine's significant potential in biofuel production, especially in agricultural regions, investments in this sector can serve as a powerful driver of regional development. Utilizing local raw materials for biomass energy production will not only reduce dependence on traditional energy sources but also create additional jobs, fostering economic growth in communities.

Successful cases of public-private partnership projects in Ukraine demonstrate the potential of this tool for the effective implementation of infrastructure initiatives (Petrova I.P., 2024b). One such example is the biofuel heating project in the city of Malyn, established on September 19, 2014, between the Malyn city community and LLC "Energiya Tepla." The 15-year contract aimed to improve the city's energy efficiency and reduce its dependency on imported natural gas by using local resources to heat public facilities (U-LEAD, 2017).

The main goals of the project included enhancing energy independence, reducing the impact on climate change, and stimulating the development of new PPP projects. The contract provided for the modernization of the heating system, ordering and manufacturing of the necessary equipment, installation work, installation of a new solid-fuel boiler, and the subsequent operation of the system. An essential aspect of the project was the replacement of a gas boiler with a solid-fuel boiler, allowing local schools and sports facilities to receive heating at a reduced rate. This also led to job creation and promoted the development of small businesses in the region.

The project was implemented in a BOT (build-operate-transfer) format, enabling the city to receive thermal energy at a reduced rate while the private partner could realize investments and receive profit over the 15-year contract period. Malyn's successful experience served as an example for other communities seeking to switch to renewable fuels and reduce dependence on expensive imported energy resources. It showcased the effectiveness of the PPP mechanism in attracting private sector financial resources and technology for managing infrastructure projects.

Another notable example is the heat energy production project in the city of Oster, aimed at modernizing the region's heating system. Project implementation, which began in June 2015, was carried out under a joint activity agreement between the Oster City Council and the corporation "Ukratoprylad" for 25 years (U-LEAD, 2017). The main goal of this project was to reconstruct the heating networks supplying heat to public facilities, particularly kindergartens, schools, and other social institutions.

The project included plans for the reconstruction of boiler houses, construction of a new section of the heating network, and obtaining all necessary permits and licenses to operate the new equipment. According to information from the Chernihiv Regional State Administration (U-LEAD, 2017), a significant portion of the planned work was completed: comprehensive reconstruction of boiler houses was carried out, new solid-fuel boilers running on biofuel were installed, and a new heating pipeline section was built to connect the heating networks of both boiler houses.

Thus, the project in Oster demonstrates a successful PPP example that not only improved the technical condition of the heating networks but also enhanced the quality of heating services. It also emphasizes the importance of collaboration between government bodies and private companies in implementing infrastructure projects that have a significant socio-economic impact on local communities. These examples confirm the potential of public-private partnerships in Ukraine as an effective tool for addressing infrastructure challenges and promoting regional development.

For Ukraine, it is essential to implement such successful practices adapted to local conditions (Hryshchenko S., 2011). This can be achieved by developing regional strategies based on smart specialization, which will allow identifying priority areas for the development of each community and attracting investors for their implementation (Derhach A.V., 2024). In addition, work needs to continue on improving PPP legislation, particularly regarding simplifying contract conclusion procedures and increasing transparency in project implementation.

Thus, the development of infrastructure-service projects based on public-private partnerships is a key tool for restoring and developing Ukraine's territorial communities in the post-war period (Nehrych M.M., Korzh R.V., 2024).

8.2 Key directions for using public-private partnerships in the restoration and development of infrastructure in territorial communities

In the context of limited public resources and the growing needs of communities for infrastructure modernization, PPP serves as a cooperation mechanism between the state and the private sector, enabling the pooling of resources, knowledge, and capabilities to achieve shared goals (Prokopchuk M.V., 2020). The role of PPP in the development of territorial communities is well-defined by its ability to secure additional funding, improve project management efficiency, and implement innovations that are challenging to realize within traditional public financing frameworks (Deyeva N.E., Khmurova V.V., 2018; Prylipko S.M., 2020).

A primary role of public-private partnership is to address the financial deficits often faced by territorial communities. In cases where local budgets cannot independently cover the costs of large-scale infrastructure projects, the private sector provides the necessary capital. This enables projects such as road construction, bridges, schools, hospitals, and water and sewage systems, which form the foundation for sustainable community development (Ampratwum, G., Tam, V.W.Y., and Osei-Kyei, R., 2023). PPP also facilitates risk-sharing between the parties, reducing the financial burden on the public sector.

Another significant role of PPP is enhancing the quality and efficiency of infrastructure project implementation. Private partners typically bring expertise, technologies, and management skills that can significantly improve the design, construction, and operation processes of projects. Businesses involved in PPPs are interested in the long-term success of the project, as their investments are directly tied to its outcomes (Liu, L.X., Clegg, S., & Pollack, J., 2024). This approach ensures not only timely project completion but also adherence to high-quality standards, contributing to improved community living standards.

Innovation is another crucial advantage of PPP. The private sector often has access to advanced technologies that can be introduced into communities through partnership. This is particularly

important in the context of digitization and the shift to environmentally friendly solutions (Omelianenko, O., Petrova, I., Chashechnikova, O., Yurchenko, O., Lytvynenko, S., and Berezova, S., 2022). For instance, PPP projects can include the implementation of smart management systems for energy, water, and waste, which not only reduce costs but also enhance the environmental efficiency of communities.

PPP also plays a key role in the development of social infrastructure. Through such partnerships, territorial communities have the opportunity to establish new educational institutions, medical facilities, sports complexes, and cultural venues (Fabre, Anaïs, Stéphane Straub, 2023). These initiatives contribute to improving the quality of education, access to healthcare, and overall social well-being. For many communities, these facilities are fundamental to human capital development and building a healthy society.

Equally important is the role of PPP in strengthening the competitiveness of territorial communities. Quality infrastructure is a vital factor in attracting new investments and fostering the development of small and medium-sized enterprises (Callens C., Verhoest K., Boon J., 2022). Modern infrastructure facilities, such as industrial parks, transport hubs, or e-commerce facilities, can be established on the basis of PPP, which in turn enhances the community's economic potential and promotes job creation (Azarian M., Shiferaw A.T., Stevik T.K., Lædre O., Wondimu P.A., 2023).

In summary, public-private partnerships are crucial for the development of territorial communities, as they allow for not only the attraction of additional financial resources but also the enhancement of quality, efficiency, and innovation in infrastructure projects (Shylepnitskyi P.I., 2011). Given the increasing challenges and needs of communities for modernization, PPP stands as a key mechanism for sustainable development and the strengthening of social and economic infrastructure (Table 8.2).

Table 8.2. Key Directions for Using Public-Private Partnerships in the Restoration and Development of Territorial Community Infrastructure

Direction	Description	Implementation Examples
E-commerce and e-business infrastructure	Development of digital platforms for managing financial and material flows: e-contract, e-invoicing, e-logistics.	Implementation of an electronic logistics platform to streamline goods delivery processes in communities. Integration of e-contract systems to simplify business transactions between community entrepreneurs and international partners.
Life support infrastructure	Restoration and modernization of healthcare, education, transport, and public safety systems.	Development and launch of a telemedicine platform in communities with limited hospital access. Modernization of schools with remote learning capabilities to ensure continuous education during wartime and recovery.
Geoinformation infrastructure	Systems for collecting, storing, and processing data related to territories, land use, and infrastructure facilities.	Creation of a geographic information system for land resource management in communities. Reconstruction of damaged infrastructure facilities using spatial planning based on modern digital solutions and mapping data.
Improving social determinants of public health	Improving healthcare, enhancing access to quality education and essential services.	Construction of new healthcare centers or modernization of existing ones through public-private partnership. Modernization of educational infrastructure with new schools and universities to attract young people for local education.

Source: Akomea-Frimpong, I., Jin, X., Osei Kyei, R., Tetteh, P.A., Tumpa, R.J., Ofori, J.N.A., and Pariafsai, F., 2024; Datsenko V., Grechukha D., Cherevykov E., 2023; Tavana, M., Nasr, A.K., Mina, H., & Michnik, J., 2022; Guarini MR, Morano P, Micheli A, Sica F., 2021.

In today's world, digital technologies have become an essential element of development and functioning in territorial communities. E-commerce and e-business infrastructure is a key aspect that ensures the integration of local economies into global markets. In this context, public-private partnership can become a powerful tool for providing communities with access to modern digital technologies and solutions that enhance business process efficiency (Omelianenko, O., Petrova, I., Chashechnikova, O., Yurchenko, O., Lytvynenko, S., and Berezova, S., 2022).

PPP can stimulate the development of digital platforms, which are fundamental for managing financial and material flows in e-commerce. For example, the use of systems such as e-contracts (electronic contracts) allows for the automation of agreements between parties, simplifying legal procedures and increasing the speed of deal-making (especially important in resource-limited settings, as it saves time and funds); e-invoicing (electronic invoices) simplifies the billing process, reducing errors and payment delays. The introduction of electronic invoices enables public organizations and entrepreneurs to receive payments faster, improving cash flow; e-logistics (electronic logistics) optimizes goods delivery processes and inventory management. Using modern technologies for logistics planning and monitoring reduces transportation costs and increases customer service efficiency.

The development of e-commerce through public-private partnerships enables communities to integrate into global markets, opening new opportunities for local entrepreneurs. Access to international trading platforms and markets allows small and medium-sized businesses to reach a broader consumer base, enhancing their financial performance. This, in turn, promotes job creation and boosts economic activity in communities. By implementing digital solutions, communities can significantly improve business process efficiency by automating routine tasks, allowing entrepreneurs to focus on the strategic growth of their business; reducing management costs; and optimizing business operations through electronic systems, which in turn decreases operational expenses. Enhanced customer service is also achieved through quick access to information and user-friendly digital

platforms, contributing to increased consumer satisfaction, a crucial factor for business competitiveness (Public-private partnership Resource Center, 2024a).

The establishment of modern e-commerce and e-business infrastructure within PPP creates favorable conditions for local entrepreneurship. Since small and medium-sized businesses form the economic foundation of local communities by providing employment and stability, entrepreneurship growth leads to an increased economic potential and resilience of communities, especially for post-war recovery.

Thus, the implementation of e-commerce and e-business infrastructure through public-private partnerships is a strategically important step in the development of Ukrainian communities. It not only promotes economic growth but also enhances the quality of life for the population, creating conditions for innovative development and social stability.

Essential infrastructure is a critical component for the sustainable development of local communities. It encompasses key areas such as healthcare, education, transportation, and public safety (Kharchun V.M., 2024). Due to war and economic challenges, these infrastructures have suffered significant damage, and their restoration requires considerable effort and resources. The healthcare sector is one of the most vital for community welfare, and public-private partnerships play a key role in modernizing and improving medical facilities (Abuzaineh N., Brashers E., Foong S., Feachem R., Da Rita P., 2018). Through PPPs, private investments can be mobilized for the renovation and equipping of hospitals with modern medical technology, which enhances the quality of healthcare services, access to medical assistance, and treatment effectiveness.

Private investors can finance such projects, offering resources, technology, and management expertise. In return, they may receive a portion of the revenue generated by hospital operations or other benefits, such as tax incentives, guaranteed service purchases, or profit-sharing from healthcare services.

An example of PPP implementation in healthcare could be the construction of new medical facilities, which not only improve infrastructure but also create new jobs in the regions. Private

companies can take on the obligations of designing, building, and operating new hospitals or medical centers, equipped with advanced technology, equipment, and professional staff. This reduces the financial burden on public budgets while simultaneously enhancing the efficiency and quality of healthcare services. Additionally, PPP projects in healthcare can include training programs for medical personnel, the introduction of advanced technologies and treatment methods, and the development of telemedicine, which is particularly important for remote regions. Collaboration between public bodies and private investors provides a comprehensive approach to improving healthcare services and promotes overall public health.

PPP in the healthcare sector is an effective tool for enhancing healthcare services, supporting infrastructure development, and attracting investments to critical social sectors, ultimately improving the quality of life in communities.

Education is another critical aspect of essential infrastructure, and public-private partnerships can significantly contribute to its development, especially in the face of modern challenges such as the COVID-19 pandemic and war. PPPs can be used to implement digital platforms for distance learning, which has become particularly relevant in recent years (De Ramos Z., Revilla N., 2022).

The implementation of digital platforms for distance learning became crucial with the COVID-19 pandemic, which drastically increased demand for online education. Private companies can offer solutions that enable educational institutions to efficiently organize high-quality remote learning. This includes the creation of interactive platforms that support both synchronous and asynchronous learning, allowing real-time interaction between students and teachers or access to educational materials at any convenient time. Such technologies play a key role in maintaining educational continuity during crises, adapting to new conditions, and ensuring stability in the learning process.

Modernizing educational institutions with private sector involvement is an essential component of PPP in education (Aslam, M., Rawal, S., and Saeed, S., 2017). Private investors can support the renovation of school and university infrastructure, equipping them with modern technology—interactive whiteboards, computer labs,

and laboratories – and providing high-speed Internet access. This fosters a favorable learning environment that motivates students to develop their skills.

Contemporary education must meet labor market demands, which require not only knowledge but also proficiency with advanced technologies (Harry A. Patrinos, 2023). Joint development of modern curricula in partnership with private companies allows the integration of practical experience, enhancing the competitiveness of graduates.

Collaborating with businesses through PPP also facilitates the establishment of partnerships between educational institutions and enterprises, providing opportunities for internships, practical training, and workforce preparation. This is a key factor in developing practical skills in students, preparing them for real working conditions.

Thus, PPP in education has the potential to significantly improve the quality of education, provide access to modern technologies, and create effective educational infrastructure. In light of current challenges such as the pandemic and war, these initiatives can become crucial for sustaining and advancing the educational process, equipping young people with the knowledge and skills necessary for a successful future.

Transportation infrastructure is the backbone of economic development and social integration, and public-private partnerships have the potential to significantly improve this sector. A key area of cooperation is the reconstruction and modernization of transportation systems (Du J., Wang W., Gao X., Hu M., Jiang H., 2023). Private companies can participate in the construction of new roads, bridges, tunnels, and railways, improving regional accessibility and reducing travel times between them. This, in turn, fosters economic ties, stimulates trade, and creates new business opportunities.

PPP allows for the use of private sector financial and technical resources to upgrade aging infrastructure, which is particularly relevant for post-conflict regions. Private investments can be directed towards the restoration and development of transportation hubs, improving logistics processes, and reducing transportation costs for businesses and citizens. Additionally, modernizing transportation

systems will enhance road safety and environmental sustainability.

Another important aspect of PPP in transportation is the implementation of modern solutions for public transport. Private companies can develop and introduce technologies that increase the efficiency and convenience of transport services. For example, electronic ticketing systems automate fare payment processes, reduce administrative costs, and make transportation more convenient for passengers. Mobile applications for transport management can provide real-time information on transport schedules and route congestion, allowing passengers to optimize their time and choose the most efficient means of travel.

Moreover, partnerships between the state and private sector in transportation can facilitate the adoption of environmentally friendly modes of transport, such as electric buses and trams, reducing environmental pollution. Private sector investments can be allocated to purchasing new eco-friendly vehicles, modernizing depots, and building power stations for maintenance, helping the country achieve its sustainable development goals.

Thus, public-private partnerships in transportation hold great potential for improving infrastructure, enhancing transportation efficiency, and creating comfortable conditions for transport users. Joint projects can not only address current issues but also contribute to the long-term development of the transportation system, improving citizens' quality of life and stimulating economic growth.

Ensuring public safety is one of the key factors for the stability and development of communities, and public-private partnerships can become an important tool in addressing this issue. One area where PPP can make a significant contribution is in the development of monitoring and response systems (The United Nations Interregional Crime and Justice Research Institute, 2024). Private companies can provide technological solutions, such as surveillance systems, alarm systems, or other monitoring tools, which enable continuous control over the safety of public spaces, transportation infrastructure, schools, and hospitals. The use of modern technologies allows for the quick detection and prevention of crimes, effective incident response, and improved local safety management.

Another important aspect of PPP in the field of public safety is

the creation of training and education programs for security services. The private sector can help develop and implement modern training programs to improve the skills of police officers, rescuers, firefighters, and other emergency service workers. Such programs may include training on the use of new technologies, counter-terrorism strategies, cybersecurity, and natural disaster response. This enables security personnel to gain new skills and knowledge, enhancing their effectiveness in handling complex tasks.

Furthermore, private companies can provide financial and technical resources for the modernization of equipment used by security services, such as vehicles, communication tools, and specialized data management software. Significant improvements in the operational capabilities of security services will ensure a rapid response to emergencies.

Thus, collaboration between the state and the private sector in ensuring public safety can lead to a substantial improvement in the quality of life for citizens. Modernizing monitoring systems, developing training programs, and implementing advanced technologies contribute to enhanced community protection, a key factor in creating a stable and secure environment for social and economic development.

Therefore, implementing public-private partnerships in the area of essential services is an important step toward the sustainable development of territorial communities. PPP not only supports the restoration of critical infrastructure but also creates conditions for improving the quality of life for the population by ensuring access to healthcare, education, transportation, and safety. The involvement of private investments and technologies will promote faster post-war recovery and strengthen the social and economic stability of communities.

Effective resource management for territorial communities, especially in the post-war period, is a complex task requiring a developed geoinformation infrastructure (Public-private partnership Resource Center, 2024b). This infrastructure facilitates the collection, storage, processing, and analysis of geographical data, which is crucial for planning, managing, and implementing various projects within communities. Public-private partnerships can play a

key role in the development of geoinformation systems (GIS) by providing the necessary resources and technologies. Specialized platforms for data collection and processing can be developed within PPPs, focusing on land use (systems can help monitor land use, identify inefficient practices, and plan for rational land utilization); infrastructure assets (GIS allows for inventory and assessment of infrastructure, enabling timely detection of repair or reconstruction needs); and natural resources (data collection on resources like water, forests, and minerals promotes their efficient use and preservation).

Geoinformation infrastructure is an important tool for effective resource management and community recovery. Through PPP implementation, communities gain access to the latest technologies and expertise, which helps improve planning, management, and rational use of natural resources. This, in turn, supports the sustainable development of communities in the post-war period, facilitating their integration into the economic and social contexts of the country.

Improving the socio-economic determinants of public health is a crucial condition for the sustainable development of territorial communities. The health of the population depends not only on access to medical services but also on the overall level of infrastructure, including healthcare, education, transportation, and other services. Public-private partnerships can be an effective tool for implementing projects that positively impact the well-being of the population and create conditions for social stability. Improving access to healthcare can be achieved by attracting private investment in the construction of new medical facilities or the modernization of existing ones, enabling access to quality healthcare even in remote or underserved areas. For example, opening new hospitals or clinics will reduce the time needed to receive medical assistance, which is critical for emergency care.

An important direction in healthcare is the introduction of new medical technologies, such as telemedicine. Telemedicine allows patients to consult doctors without needing a physical presence, which is especially valuable for people with limited mobility or those living in remote areas. It also helps reduce the burden on hospitals, reserving their resources for patients requiring urgent medical care.

Moreover, PPPs can help enhance the quality of healthcare by financing the purchase of modern medical equipment, which enables timely diagnosis and treatment of diseases.

Another key aspect is the modernization of educational institutions. Through PPPs, communities can implement projects to construct new schools, universities, vocational training centers, and to renovate existing ones. These initiatives will improve the quality of education and create a modern learning environment. Integrating information and communication technologies into educational programs, such as digital platforms and electronic libraries, will better prepare young people for work in contemporary conditions.

Access to technology plays a significant role. Integrating digital technologies into the learning process helps develop the skills needed to work in the modern labor market. Creating conditions for social integration through educational projects strengthens the bonds between youth and the community, fostering social skills and leadership qualities.

Thus, implementing infrastructure projects within PPP frameworks directly impacts the improvement of the socio-economic determinants of public health. Partnership between the government and business not only enhances the quality of life for the population but also creates conditions for sustainable economic growth, reduces disease rates, and improves social stability. In today's context of economic challenges and environmental threats, such projects should be a priority for local communities striving to develop infrastructure and improve the quality of life for their residents.

At the same time, implementing PPPs requires a clear strategy and proper planning, including the development of pilot projects that will allow for assessing the effectiveness of new initiatives before their large-scale implementation. A critical aspect is the alignment between the public and private sectors, along with adequate legislative and financial support for successful project implementation at the national level.

8.3 Recommendations for implementing infrastructure and service projects in territorial communities in the context of post-war reconstruction

Public-private partnerships serve as an effective mechanism for attracting investment and innovative solutions to vital infrastructure and socio-economic projects. Each initiative—from environmental and energy-saving projects to digitalization and health development – holds the potential to improve living conditions, create new jobs, and promote economic stability within communities. By integrating the private sector with public initiatives, the possibilities for implementing large-scale projects significantly increase, which will ultimately yield economic, social, and environmental benefits for all stakeholders (Shchur R.I., Kropelnytskyi A.O., 2023).

Modern communities face numerous challenges related to environmental changes, social inequality, and economic instability. Consequently, ensuring ecological and economic well-being becomes critically important for developing human capital (Koval V.V., Kotlubai V.O., Arafteiniy A.M., 2019). Public-private partnership emerges as an effective mechanism for implementing innovative infrastructure and service projects capable of addressing these urgent issues (Lukyanenko I.H., Maryanovych M.E., 2020). Important stages for the successful implementation of such projects include preliminary research of local conditions, stakeholder engagement, preparation of feasibility studies, seeking potential investors, development of pilot projects, and monitoring results.

Preliminary research of local conditions is the first and most crucial step in implementing PPP-based projects. Conducting a detailed analysis of community needs, including the examination of socio-economic aspects, the level of infrastructure development, and ecological challenges, allows for identifying the most relevant areas for project implementation. For instance, rural areas may need improvements in access to clean water, while urban communities may focus on modernizing transportation systems. The importance of this stage cannot be overstated, as it lays the foundation for all subsequent actions. The results of such studies not only reveal

existing problems but also formulate solutions that positively impact residents' quality of life. This may include, for example, developing energy efficiency projects that help reduce energy costs for households.

Engaging stakeholders is the next important stage that ensures the legitimacy and support of projects. Active collaboration between local authorities, businesses, civil society organizations, academic institutions, and international partners creates a platform for open dialogue. Such cooperation enhances the level of social support for projects, as involving citizens in discussions about development priorities fosters a sense of ownership over changes in their environment. This dialogue can occur through public hearings, consultations, and informational campaigns, allowing for the consideration of local residents' opinions and desires. As practice shows, successfully implemented projects often arise from deep integration of local needs and preferences into the overall development plan. Thus, in many communities where active project discussions took place, there was a high willingness among the population to support and participate in implementation.

Preparing feasibility studies is a critically important stage that allows for assessing the realism of projects. This stage involves a comprehensive analysis of costs and benefits, risk assessment, identification of funding sources, and the development of an implementation plan. Utilizing various analytical methods, such as SWOT analysis or sensitivity analysis, helps identify project weaknesses and timely adjust strategies. For example, when developing projects in the renewable energy sector, it is essential to anticipate all potential risks related to technological innovations and changes in the market situation. A clear justification of the project not only helps avoid potential problems in the future but also ensures transparency in financial matters, which is an important factor for attracting investors.

Finding potential investors and partners is critically important for the successful implementation of innovative projects. This includes not only securing funding but also creating constructive dialogue with potential investors, which can enhance project quality. It is important to develop attractive collaboration conditions that

include risk-sharing and ensuring transparency in financial operations. For example, attracting international financial institutions and grant programs can significantly strengthen the financial foundation of the project. Additionally, creating mechanisms to ensure the transparency of financial flows will help build trust in project implementation from both the public and investors.

The development of pilot projects with a focus on scalability is an important stage that allows testing new ideas on a limited scale before broad implementation. Pilot initiatives should have a clear development strategy that allows for their adaptation to the conditions of other communities. For instance, the implementation of a waste recycling project could serve as a basis for establishing a network of similar enterprises in other communities. Successful examples of such projects can serve as a foundation for further scaling, demonstrating the benefits of PPP cooperation to other communities. According to research findings, pilot projects that have proven effective often lead to increased investment and community activity as a whole.

Monitoring and evaluating results is the final stage that allows for determining the effectiveness of projects and their impact on the local economy and ecology. This process involves regular data collection on project implementation results, their impact on the community, as well as identifying successful practices and shortcomings. Using performance indicators, such as reduced energy costs, improved quality of life, and decreased emissions of pollutants, helps to identify real changes occurring in communities. This approach not only contributes to improving current projects but also provides valuable experience for future initiatives.

In summary, recommendations for selecting innovative infrastructure and service projects based on PPPs form the foundation for ensuring ecological well-being, economic resilience, and improved quality of life for the population (Dubel M., Pashchenko A., 2023). Based on this, it is advisable to consider specific proposals that can significantly impact the sustainable development of communities and regions.

Proposal 1. Selection of projects for the development of ecological infrastructure for sustainable natural resource and waste

management. Priority areas for ensuring environmental well-being include waste management, preservation of water resources, and the development of renewable energy. Innovative projects in these areas, such as waste recycling plants, water collection and purification systems, and bioenergy installations, can be effectively implemented by attracting private investments through public-private partnerships. This will contribute to ecological recovery and sustainable development of communities. It will reduce negative environmental impacts, improve quality of life, enhance economic resilience of communities, and create new jobs in the field of environmental technologies.

Proposal 2. Development of infrastructure projects for the implementation of energy-saving technologies in the housing and communal sector. Energy-saving technologies, such as the modernization of heating systems, building insulation, and the implementation of solar and wind energy systems, are essential for improving economic efficiency and reducing environmental costs. Utilizing PPP to implement these projects will help attract the private investments and technologies necessary for ensuring energy efficiency. This will reduce energy resource consumption, lower energy costs for communities, minimize environmental impacts, and enhance the economic resilience of communities.

Proposal 3. Development of green infrastructure in communities. Green infrastructure, including parks, squares, and recreational areas, enhances the quality of life for residents and is crucial for tourism development and attracting investments. PPP can engage private investors in funding such projects, while the private sector will provide appropriate legislative and administrative regulation. This will improve public health, increase the attractiveness of areas for tourism and business, and create new recreational opportunities.

Proposal 4. Development of infrastructure to support health and well-being of the population. Infrastructure projects aimed at supporting public health, such as the construction of sports complexes, bike paths, and psychosocial support centers, have a significant impact on improving both physical and mental health. Using PPP to implement these projects will allow for the attraction

of funding for the construction and management of such facilities. This will enhance quality of life, reduce morbidity, and increase the social resilience of communities and labor productivity.

Proposal 5. Digitalization of municipal services to enhance transparency and effectiveness of community management. The introduction of electronic administrative services and systems for managing communal resources will optimize processes, making them transparent and user-friendly for residents. PPP can be utilized to attract innovative solutions and technologies that simplify administration and reduce bureaucratic hurdles. This will improve the efficiency and transparency of community management, enhance residents' access to services, and attract investments in digital infrastructure.

Proposal 6. Implementation of infrastructure projects for renewable energy development. In the context of energy independence and combating climate change, the development of renewable energy should become a strategic direction for Ukraine. Projects to build solar, wind, and bioenergy installations will not only reduce dependence on fossil fuels but also contribute to attracting investments in local communities through public-private partnership mechanisms. This will create new energy sources, enhance energy security, reduce greenhouse gas emissions, and promote economic development by attracting investments and creating new jobs in renewable energy.

Proposal 7. Creation of ecological industrial parks and clusters. The development of environmentally oriented industrial parks and clusters based on the principles of circular economy is an important direction for supporting economic growth and reducing negative environmental impacts. Through PPP mechanisms, private investors can be attracted to fund the infrastructure projects for such parks, which include waste management, resource recycling, and the use of renewable energy sources. This will improve resource efficiency, create new enterprises, reduce waste, enhance environmental indicators, and stimulate economic development in regions.

Proposal 8. Implementation of projects for the development of intelligent transport systems. The development of intelligent

transport systems (ITS) to improve traffic management, reduce congestion, and optimize transport use can be realized through PPP. This will contribute to the improvement of transport infrastructure, reduce travel times, increase road safety, and lessen the negative environmental impact of transportation. This will enhance the quality of transport services, reduce CO2 emissions, improve resource use efficiency, increase road safety, and attract investments in transport infrastructure.

Proposal 9. Support for projects to develop education and research infrastructure through PPP. To ensure long-term economic growth, it is essential to invest in the development of educational and research infrastructure. Projects for the construction of modern educational institutions, research centers, and technology parks can be implemented through PPP, allowing for the attraction of private funds to finance innovative educational and research projects. This will enhance the quality of education, develop the country's scientific potential, stimulate innovation, and create conditions for attracting investments in high-tech industries.

Proposal 10. Development of inclusive programs for socially vulnerable groups of the population. Supporting socially vulnerable groups, such as individuals with disabilities, the unemployed, youth, and veterans, is an important element of social policy. Through PPP mechanisms, programs for training, retraining, job creation, and social integration can be implemented, improving their quality of life. This will reduce social inequality, increase employment levels, enhance the social climate in communities, and create conditions for social development.

Proposal 11. Implementation of energy-saving projects in the housing sector. Energy efficiency in the housing sector is a key aspect of reducing energy consumption and costs. The implementation of energy-saving programs, such as building insulation, modernization of heating and lighting systems, can be achieved through PPP mechanisms, allowing for the attraction of investments and technologies to enhance energy efficiency. This will reduce energy costs for residents, improve the comfort of living conditions, enhance environmental safety, and reduce greenhouse gas emissions.

Proposal 12. Creation of an online platform for public discussion and engaging residents in decision-making processes. Engaging citizens in decision-making processes through online platforms can enhance transparency and efficiency in local governance. Through PPP, tools for actively involving residents in management processes can be created, providing more opportunities for discussion, feedback, and initiatives. This will increase public participation in local self-government, improve trust in authorities, and enhance transparency and accountability in decision-making.

The implementation of infrastructure-service projects based on partnerships between the government, business, and society in Ukraine holds strategic importance for achieving three main goals: environmental well-being, economic resilience, and improving the quality of life for the population. First and foremost, such projects ensure the integration of environmental norms and standards into the planning and implementation processes of infrastructure solutions, which not only helps preserve natural resources but also reduces negative impacts on the environment and enhances the level of ecological safety in territorial communities.

Secondly, the economic resilience of communities is shaped through the creation of new jobs, attracting investments, and developing local entrepreneurship. Infrastructure-service projects stimulate economic activity by creating favorable conditions for doing business and fostering innovative solutions that can adapt to changing market conditions. This is particularly important in the context of the ongoing challenges faced by Ukraine's economy, especially in the conditions of war and post-war reconstruction.

Furthermore, the implementation of such projects improves the quality of life for the population by providing access to modern services and enhancing infrastructure, which serves as a foundation for developing social and economic initiatives. Ensuring the population has access to quality services such as water supply, energy supply, transportation, healthcare, and education is a necessary condition for the sustainable development of territories.

Thus, recommendations for the implementation of infrastructure-service projects can serve as a basis for a comprehensive approach to the development of territorial

communities in Ukraine. They will promote the integration of environmental, economic, and social aspects, which, in turn, will lead to the creation of more resilient and viable communities. It is essential to consider that the success of such initiatives depends on the active participation of all stakeholders—government, local authorities, businesses, and citizens. Only through joint efforts can we ensure the realization of infrastructure-service projects that not only meet modern requirements but also contribute to the sustainable development of Ukraine as a whole.

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**9. THE INFRASTRUCTURE COMPONENT OF
PRESERVATION AND DEVELOPMENT OF THE
INTELLECTUAL CAPITAL OF THE COMMUNITIES IN
THE CONTEXT OF ENSURING SUSTAINABLE
DEVELOPMENT AND IN THE CONDITIONS OF THE
POST-WAR RECONSTRUCTION OF UKRAINE**

**9.1 Development of the infrastructural component of
communities for the preservation of intellectual capital in the
conditions of post-war reconstruction of Ukraine**

Achieving the global Sustainable Development Goals of the UN is gaining more and more importance in the context of the development of territorial communities and the preservation of intellectual capital in conditions of war, especially in border communities. The development of the intellectual capital of communities is one of the main prerequisites for achieving the Sustainable Development Goals defined by the UN, and therefore requires appropriate infrastructure support. In turn, providing territorial communities with a powerful infrastructure contributes to the creation of conditions for the development of education, science, culture, entrepreneurship, innovation, digital transformation of communities and preservation of the quality of life and health as a whole. In this context, it is necessary to investigate what infrastructural solutions contribute to the preservation, progress and disclosure of the potential of communities, which in turn will stimulate sustainable development.

Problems of intellectual capital attract the attention of many foreign and Ukrainian scientists. Thus, the issue of mutual influence of intellectual capital and the efficiency of innovations was studied by representatives of the Malaysian Higher School Mostafa A. Ali, Nazima Husin, Hosam Haddad, Reem Al-Araj, Ibtihal A. Abed, the interaction of digitization and intellectual capital as an influence on sustainable open innovation is the research problem of Chinese

scientists Fuchen Yang, Chunyang Luo, and Lu Pan. The formation and reproduction of the human capital of Ukraine in the conditions of a full-scale war were the subject of research by scientists N. Azmuk, V. Antonyuk, Yu. Zaloznova, A. V. Melnyk, O. Novikova, M. V. Semikina, and A. V. Semikina. The infrastructural component of the development of the intellectual capital of local communities is highlighted in the scientific works of V. Omelyanenko, O. Omelianenko. Within the scope of our research, we will continue to analyze the development of the infrastructural component of communities in order to preserve intellectual capital in the conditions of the post-war recovery of Ukraine.

The concept of intellectual capital has been around since 1960. transformed For the first time, the term IR was used by prominent scientists Thomas A. Stewart, Annie Brooking, Leif Edvinsson, Michael S. Malone, etc. in the context of a separate direction of management related to IR management

During 1989–2002 IC was interpreted by scientists as a set of intangible assets that provide opportunities for additional income of enterprises (Prokopenko, Bosak, 2016). However, even in modern conditions, the development of technologies related to Industry 4.0 continues to change the market environment, and intangible resources (developed competencies, intellectual products, patents) are critical for the company's success (Wang, Li, Zhang, 2024).

Within the scope of current scientific investigations, we are impressed by the scientific view of Ukrainian researchers O. Mogilevska, S. Pavlovsky, S. Tsyporenko's definition of intellectual capital as the most powerful engine of economic production, which is the most important driver of smart, sustainable, inclusive economic and social development (Mogilevska, Pavlovsky, Tsyporenko, 2024), which in the context of the definition of T. Stewart, who interpreted IP as an intellectual material that includes knowledge, experience, information and intellectual property and participates in the creation of values" (Sttuart, 2010) can be interpreted as the accumulation of intangible resources, such as intellectual property, based on the expansion of knowledge, skills, experience of human potential within the organization, which will allow to influence its economic progress, development of values,

competitiveness in the foreign market, and achieve strategic goals.

Therefore, intellectual capital is a key resource of modern communities that are looking for ways for post-war economic recovery and, subject to strategic approaches, determines competitiveness, innovation potential, and the ability to achieve sustainable development in these communities. In the structure of intellectual capital, three main components are usually distinguished: human, structural, consumer. Researcher G. Kozynets (Kozynets, 2013) adds technological, information-communication, management, and organizational capital. Within the framework of our study, we will dwell in detail on the features of the main components. In particular, human capital combines the knowledge, skills, competences and creative abilities of the personnel potential of the organization, which requires investment in social and administrative infrastructure and can directly influence the development of the institution. directly affect the formation of human capital. Human capital in the works of D. Melnychuk is interpreted as a phenomenon that is not the product of an exclusively conscious choice of the employee or the intention of the employer, but, first of all, the result of the influence of various circumstances on the sphere of social and labor relations (Melnychuk, 2015). Human capital is mainly formed in the field of education (knowledge, skills, abilities, intellectual capital and potential); in the field of health care (care for a healthy lifestyle, prevention and treatment of diseases), which as a result has a positive effect on the economic provision of human capital; in the sphere of social protection of various population groups (Dzvinchuk, Bursa, 2023).

Structural capital creates a platform for effective use of human capital and consists of intangible assets of organizations and communities (infrastructure, databases, patents, information systems and corporate culture) (Ponedilchuk, 2014).

Consumer capital includes networks of connections, trust, shared values and norms that contribute to stakeholder cooperation and mutual support in the community, which in post-war recovery conditions will contribute to joint activities and support of the population.

Therefore, the development of intellectual capital requires an

integrated approach to the formation of its components. Human, structural and consumer capital are interdependent and mutually reinforcing elements at the individual (level of personnel potential), internal (organizational level) and external (group level) that create a basis for the development of community infrastructure (Table 9.1).

Table 9.1. Development of community infrastructure to preserve intellectual capital in the conditions of post-war recovery

Components of intellectual capital	Investments in the basic infrastructure of communities are necessary in the conditions of post-war recovery
Human capital (knowledge, skills, experience)	Digitization of educational, medical, legal, judicial, socio-cultural, etc. types of infrastructures. For example, the digitalization of educational platforms of schools, universities, vocational and technical education institutions, preschool education institutions, scientific institutions, educational centers will ensure the quality of education in the conditions of distance learning and equal rights to education
Structural capital (copyrights, patents, corporate management systems)	Creation of effective management of intangible assets within the framework of integration of digital and basic infrastructure, which will contribute to the development of competitiveness, creativity, flexibility, mental and financial stability of the personnel potential of communities
Consumer capital (brand, reputation, partnership)	Implementation of foreign and Ukrainian partnership initiatives within the framework of cooperation with stakeholders at the internal and external levels, which will contribute to the restoration of trust and cooperation in communities destroyed by war

Source: author` development

Thus, the presence of a powerful basic infrastructure system of the community will ensure its viability, economic resilience through the preservation of intellectual capital in particular. In particular, among the main substructures of the community's basic infrastructure development system, "communal infrastructure (facilities and networks of water drainage and water supply, heat supply, energy consumption, gas supply, communication, hydrotechnical structures) – transport infrastructure (street and road

networks, bridges, tunnels, intersections, parking lots, car repair shops, public transport, sidewalks, bike paths) – social infrastructure (security facilities health, education, culture, sports, trade, catering, fast service) – recreational infrastructure (forests, parks, squares, gardens, playgrounds and recreation) – administrative infrastructure (providing city management, providing state and municipal services)” (Kamashev, 2022; Planning for the development of territorial communities) we would also single out digital infrastructure as a complex of technologies, products and processes that provide computing, telecommunications and network capabilities on a digital basis, which will contribute to the development of the entire infrastructure system as a whole and the preservation of the intellectual capital of communities (Concept, 2018).

In this way, the infrastructure acts as a kind of catalyst for the development of intellectual capital, including: digitalization of the main processes of the basic infrastructure, the creation of effective management of intangible assets within the framework of the integration of digital and basic infrastructure, the implementation of partnership initiatives within the framework of cooperation with partners at the internal and external levels, which will contribute to the restoration of trust and cooperation in war-torn communities.

The basis for the preservation of intellectual capital in communities in the conditions of war and post-war reconstruction should be provided by: significant investments in the development of infrastructure in the sector of strengthening security and defense, establishing production, developing the competitiveness of various spheres of economic activity, ensuring the appropriate standard of living of community members (housing, education, the right to free/insurance medicine, protection, etc.), that in the conditions of restoration and development of the improvement of destroyed territories, the provision of quality services within the boundaries of individual communities and territories will contribute not only to the preservation, but also to the development of intellectual capital. The preservation of intellectual capital in the context of digitalization and the Sustainable Development Goals will be the subject of research in the next subsection.

9.2 Preservation of the intellectual capital of communities through the development of the digital infrastructure of communities in the context of the goals of sustainable development

In the conditions of war and post-war reconstruction of Ukraine, investments in high-quality basic and digital infrastructure are a priority for regional communities through the prism of preserving intellectual capital. In particular, the digitization of the basic infrastructure will provide community members with general hygienic well-being in the psychologically adverse conditions of war, post-war adaptation, will provide opportunities for the creation of additional jobs, will develop the knowledge, skills of employees, and the competitiveness of organizations. At the same time, the digital infrastructure will contribute to the modernization of the economy of the post-war country and the rapid adaptation of human capital to the requirements of the digital age and the achievement of the Sustainable Development Goals in the conditions of war.

Today, the issue of human potential formation in the context of the goals of sustainable development can be found in the works of scientists Li Y., Li J. and Zhai Y. as a new theoretical model aimed at studying the impact of three types of intellectual capital (IC) on digitalization, which affects indicators sustainable development. Trends in the development and implementation of digital technologies for the implementation of the goals of sustainable development were the subject of study by L. Fedulova, the development of intellectual capital in the implementation of all Sustainable Development Goals (SDGs), as the need to solve the most pressing global problems of sustainable development, was treated within the scope of research by Belenkova O., Loktionova Ya. , Stetsenko S., Tytok V. The development of intellectual capital through the prism of the infrastructure of local communities in scientific works is highlighted in the scientific works of Omelyanenko V., Omelyanenko O. However, a holistic scientific study of the preservation of the intellectual capital of communities through the development of basic and digital infrastructure in the context of the goals of sustainable development to date was not.

Based on the work of scientists, we note that the intellectual capital of communities is a key factor in ensuring sustainable development and combines human potential in the conditions of the functioning of the basic infrastructure, which, based on the integration of digital infrastructure, contributes to the provision of intellectual capital. The potential of digitalization, which plays an important mediating role in the relationship between IR and the effectiveness of sustainable development, is updated in the works of Lee Y., Lee J. and Zhai Y. (Li, Lee, Zhai, 2024). Such a cause-and-effect relationship provides the following advantages for organizations in conditions of economic growth:

- 1) increasing productivity, for example, through digital communication tools can reduce the need for IT infrastructure;
- 2) increasing the competitiveness of specialists, for example, the additional involvement of social networks can increase the demand for the offer;
- 3) creation of jobs in communities.

Some of the advantages of digital infrastructure for the development of human potential are: ensuring equal rights and inclusiveness of digital education; digital literacy and development of digital skills; digital economy, etc. (Omelyanenko V., Omelyanenko O., 2024). Such symbiosis will contribute to:

- 1) accumulation of intellectual capital of communities;
- 2) development of the economic potential of the regions;
- 3) sustainable development of territories.

Therefore, all the above-mentioned indicators of the infrastructure and service system (communal, transport, social, recreational, administrative) based on high-quality and mobile integration of digital infrastructure will strengthen the key aspects of preserving intellectual capital (basic safety, working conditions, equal opportunities, rights to education and protection health, etc.). In particular, the following should be mandatory: the creation of a digital network of educational institutions, taking into account domestic and international partnerships, a clear algorithm for the adaptation of veterans in post-war society, the development of digital skills of the adult population, the informatization of medical processes taking into account globalization, digital influences and

opportunities for the development of artificial intelligence and others

In our opinion, the basis of the concept of preserving intellectual capital in the context of the development of digital infrastructure is the creation of: e-systems for the field of education and health care, a secure cloud environment, database capabilities, e-document management systems, etc. At the same time, the development of the digital potential of the basic infrastructure in conditions of preservation of intellectual capital will contribute to the achievement of the Sustainable Development Goals announced by the UN (from 2016 to 2030).

Let's dwell in more detail on individual directions of digital infrastructure development in terms of achieving the Sustainable Development Goals, the main message of which is to create decent living conditions and opportunities for everyone on the planet based on creative and innovative potential to solve the challenges of sustainable development, which becomes problematic in war conditions. Researchers O. Belenkova, Ya. Loktionova, S. Stetsenko, and V. Tytok prove in their works that about 50% of the SDG can be achieved at the expense of intellectual capital by stimulating innovation and technological progress, investment in education, training and advanced training, exchange knowledge and cooperation, implementation of startups and with innovative ideas and solutions, development of effective monitoring and evaluation systems to assess progress, etc. (Belenkova, Loktionova, Stetsenko, Tytok., 2024). Therefore, the awareness of the SDG mission campaigns will be able to cover a wide range of topics of sustainable development based on health care, quality of education, etc., and in this way, combine the goals with business strategies that correspond to global priorities, digitalization, the development of S&I technologies and acquire a special significance for preserving the intellectual capital of communities. Let's consider the table of basic infrastructure development on the basis of digitalization in order to preserve intellectual capital in the conditions of achieving the objectives of the Sustainable Development Goals. Within the Table 9.2, under digital support of the basic infrastructure, we mean: "Digital infrastructure – a complex of technologies, products and processes that provide computing, telecommunication and network

capabilities on a digital basis" (Concept of the development of the digital economy and society of Ukraine for 2018-2020).

Table 9.2. Development of the basic infrastructure of communities on the basis of digitalization in order to preserve intellectual capital in the conditions of achieving the objectives of the Sustainable Development Goals

SDG	SDG task	Development of basic infrastructure	Preservation of intellectual capital	Need for digital support of basic infrastructure
SDG1	Eradicating poverty in all its forms everywhere	Housing infrastructure (linked to economic, social, and environmental shocks), land resources, support centers for low-income families or those who have experienced physical, financial, economic, or psychological abuse	Providing basic conditions (housing, education, healthcare, protection) for human potential development	AI technologies for analyzing socio-economic data, optimizing support programs, and increasing resource management efficiency
SDG2	Eradicating hunger, achieving food security, improving nutrition, and promoting sustainable agricultural development	Developing agricultural community infrastructure, farming, etc.; access to food service networks for the most vulnerable groups (children, pregnant women, retirees, people with special needs); support for small food producers (livestock breeders, fishers, etc.) in marketing their products	Optimizing the use of agricultural knowledge and technologies, accumulating knowledge, experience, and skills	AI technologies for analyzing food markets, sales platforms, or creative production strategies, access to market information

SDG3	Ensuring healthy lives and promoting well-being for all at all ages	Ensuring access to quality medical (reducing high mortality and pandemic risks through early prevention) and psychological care: psychological centers, hotlines, integration of psychological services into medical institutions; developing NGOs for programs and campaigns promoting or supporting healthy lifestyles	Strengthening physical and mental health to enhance productivity, creativity, and social stability, as well as recruiting, training, and retaining medical personnel in communities	Digital healthcare solutions under human supervision, developing AI applications for medical risk diagnosis
SDG4	Providing quality education and lifelong learning opportunities for all	Developing educational institutions (preschool, general secondary, higher, vocational education, extracurricular education for children, adult retraining), ensuring digital learning tools and equal access to education (gender and inclusive equality), including professional education centers and clusters for ICT learning, technical, engineering, and scientific hubs	Improving human potential education levels through access to knowledge, forming qualified personnel through formal, informal, and non-formal education with integration of sustainable development principles, human rights, gender equality, promoting a culture of peace and non-violence, and cultural diversity values	Using online educational platforms, adaptive AI-based learning to enhance education accessibility and ensure a safe, barrier-free, effective offline and online learning environment
SDG5	Ensuring gender equality, empowering all	Social protection facilities and strategies/programs for gender equality support	Enhancing social stability of working women through equal opportunities,	Platforms and products for social protection and gender equality

	women and girls		improving family financial well-being, etc.	support
SDG6-7	Ensuring availability and sustainable management of water resources; access to affordable, reliable, modern energy sources for all	Building water purification and supply systems. Developing of renewable energy infrastructure.	Improving living conditions to support social and cognitive stability	Managing energy flows, forecasting energy situations using AI technologies, supporting energy innovation.
SDG8	Promoting full and productive employment and decent work for all	Entrepreneurial centers, vocational training institutions, employment centers, refugee support funds, etc.	Increasing employment, developing entrepreneurship, and creating new jobs	AI platforms for labor market analysis, employment forecasting, retraining programs, etc.
SDG9	Building resilient infrastructure	Developing innovation centers, research centers, technology parks, and industries based on clean and eco-friendly technologies and processes	Supporting research initiatives and fostering creativity and competitiveness	Applying AI for predicting technological trends, developing innovations based on academic ethics and integrity
SDG10	Reducing inequality within and among countries	Social integration centers, digital platforms for accessing social services	Reducing social barriers, access to education, jobs	Tools for equal access to social programs, administrative and e-services

SDG11	Safety, ecological sustainability, resilience of cities	Developing of administrative, transport and social infrastructure.	Improving quality of life and well-being through sustainable development	Smart city management technologies
SDG12	Transitioning to sustainable consumption and production models	Waste management systems, recycling technologies	Eco-friendly production	Automating eco-production technologies and principles
SDG13	Taking action to combat climate change	Infrastructure for energy conservation	Supporting ecological knowledge and innovations	Automatic climate monitoring
SDG14	Conservation and sustainable use of oceans, seas, and marine resources	Developing of ecological regional tourism	Preserving ecological knowledge and marine ecosystems as a natural heritage for future generations	Automatic ocean monitoring systems
SDG15	Promoting sustainable use of biological resources	Creating of legal, ecological organizations	Supporting scientific research in nature conservation and social well-being	Automatic ecosystem monitoring
SDG16	Promoting peaceful and inclusive societies, ensuring	Legal aid centers, population protection	Strengthening social trust in communities and countries	Digital platforms for transparency in judicial, legal, and economic systems of open societies

	access to justice			
SDG17	Strengthening means of implementing sustainable development through global partnerships	Operating a technology bank and mechanisms for science, technology, and innovation development	International cooperation and knowledge exchange, enhancing competitiveness	Digital platforms for international collaboration, analytical systems

Source: author` development based on SDGs

The analysis of the table "Development of the basic infrastructure of communities based on digitization for the preservation of intellectual capital in the conditions of achieving the objectives of the Sustainable Development Goals" makes it possible to establish that in order to solve one of the most important problems of the preservation of intellectual capital in conditions of war, it is necessary to rebuild not only the destroyed basic infrastructure, but to pay attention the formation of a new quality of infrastructure restoration based on digital, which will contribute both to the preservation of intellectual potential and its development, and through the economic growth of communities will affect the fulfillment of the tasks of the Sustainable Development Goals. In particular, the realization of the right to housing, education, medicine, the formation of the necessary digital skills in specialists at the workplace or training place, a favorable natural environment, an effective state management system in the conditions of digital infrastructure will contribute to the development of the competitiveness of organizations, campaigns, the attraction of infections, and the flourishing of communities due to investing in digital infrastructure development, which will strengthen intellectual capital. It is important to involve S&I technologies to analyze socio-economic data, optimize support programs and increase the efficiency of resource management, provide analysis of the functioning of food markets, sales platforms or creativity in the

creation of products, analysis of market information; digital solutions for medicine under clear human guidance, development of AI applications in the diagnosis of medical risks: use of online educational platforms, adaptive learning based on AI to increase the accessibility of education and ensure a safe, free from violence and social barriers, effective offline and online learning environment; platforms, products for social protection and support of gender equality; digital energy efficiency resources; legal responsibility; employment forecasting, reorientation programs; application of science and technology for forecasting technological trends, development of innovations on the basis of academic ethics and integrity; tools of equal access to social programs, administrative and e-services, technologies of smart city management, automation of technologies and principles of eco-production, automatic monitoring of the climate and ecosystems of ecosystems, which will generally contribute to the achievement of the objectives of the Strategic Development Goals. Today in Ukraine, the successful modernization of the digital infrastructure in the field of education is the "All-Ukrainian School Online (VSHO), measures for the safety of the population of the application "Tryvoga", the e-document circulation platform "Action: State services online": automatic registration of FOP, digitization of civil acts, the latest the large-scale project "eSupport" in 2023 became an innovation not only for Ukraine, but also for the whole world (Ministry of Digital Transformation); in the field of private business: services for fast delivery of goods "Nova poshta", marketplace "Rozetka", banking services "monobank", in the media sphere innovation factory "Megogo" and others.

Thus, investments in the potential of digitized infrastructure in the conditions of war and post-war recovery of Ukraine will contribute to the development and preservation of intellectual capital, in particular on the basis of investments in human (personnel reserve), structural (intangible assets), consumer (corporations) capital, the totality of which will be able to transform post-war challenges and opportunities for growth, which is confirmed by the main thesis of the Forum "Human Capital - 2024" program: "Today it is not enough to invest only in economy, production or technology. Investments in people, their skills, are no less important." In our

opinion, investments in the support and development of corporate consulting are also important, as a harmonious, healthy, tolerant and ethical environment of organizations and state institutions of a post-war country, for which the preservation of intellectual capital and human potential, along with sovereign and territorial integrity, is a priority. which will be the subject of further scientific investigations.

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10. SUSTAINABLE INFRASTRUCTURE: CONCEPT AND PRACTICAL ISSUES⁵

10.1 General idea of sustainable infrastructure

Sustainable infrastructure is a transformative approach to building systems that are not only durable but also socially inclusive, economically viable and environmentally responsible. Its core aim is to meet current needs without compromising the resources or environmental health of future generations. This involves rethinking traditional infrastructure systems such as energy, water, transport and waste management to incorporate principles of resilience, efficiency and minimal environmental impact.

Environmental considerations are crucial in sustainable infrastructure, as these projects are designed to reduce emissions, minimize resource use and protect ecosystems. Sustainable infrastructure embraces renewable energy sources such as solar, wind and hydroelectric power, which play a vital role in reducing carbon footprints. Building materials are increasingly selected for their low environmental impact, incorporating recycled or locally-sourced options that lower emissions associated with production and transport. Sustainable infrastructure projects may also focus on green construction techniques, like using modular designs or passive heating and cooling, which reduce the need for energy-intensive processes. Additionally, sustainable infrastructure can include “natural infrastructure” solutions, like green spaces and wetlands,

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which help in water management, reduce heat and support biodiversity.

Socially, sustainable infrastructure is a path toward equity and accessibility, particularly in underserved and developing regions. Infrastructure that prioritizes access to clean water, reliable electricity and efficient transportation can significantly improve the quality of life. For instance, in urban areas, accessible and affordable public transportation reduces the need for private cars, alleviating congestion and pollution while making mobility equitable. In rural regions, sustainable infrastructure can provide critical connections to education, healthcare and economic opportunities, enabling social mobility and inclusion. Stakeholder engagement is a hallmark of sustainable infrastructure development, as it ensures that projects align with the needs and values of the communities they serve, incorporating the perspectives of marginalized groups to promote inclusivity.

From an economic perspective, sustainable infrastructure is increasingly seen as a wise investment due to its long-term cost savings and potential for job creation. While initial costs may be higher than traditional projects, the efficiencies gained in energy use, maintenance and longevity often lead to significant savings over time. Moreover, the demand for green infrastructure creates new economic opportunities in the renewable energy, technology and sustainable construction industries. By creating resilient systems that can withstand shocks, such as natural disasters or market fluctuations, sustainable infrastructure reduces vulnerability and increases economic stability. Governments and private investors are recognizing these benefits, leading to more funding for sustainable projects and favorable policies that incentivize green investments.

Climate resilience is another critical component of sustainable infrastructure, especially as climate change intensifies the frequency and severity of natural disasters. Infrastructure systems are increasingly designed to be adaptable to extreme weather conditions, such as flooding, drought, or hurricanes. For example, flood-resistant buildings, permeable pavements and coastal barriers protect against storm surges and heavy rainfall, mitigating damage in vulnerable areas. By designing infrastructure with resilience in mind,

communities are better protected and recovery costs are significantly reduced. Resilience planning also considers interdependencies among infrastructure systems; for example, power outages can impact water supply and healthcare services, underscoring the need for integrated and durable solutions.

Technological advancements play a pivotal role in enabling sustainable infrastructure. Smart infrastructure, which integrates digital technologies such as IoT sensors and AI, allows for real-time monitoring and management, optimizing performance and reducing waste. For instance, smart water systems can detect leaks early, preventing water loss, while energy grids with advanced management capabilities can balance supply and demand more effectively, reducing the need for fossil-fuel backup power. Data-driven decisions based on predictive analytics enhance the efficiency and reliability of infrastructure and technological innovation enables more sustainable urban planning, transportation and energy distribution systems.

In urban settings, sustainable infrastructure is also closely linked with sustainable city planning. As cities grow, they face challenges such as pollution, housing shortages and infrastructure strain. Sustainable urban infrastructure includes green buildings, efficient public transportation networks, waste reduction programs and renewable energy grids. Transit-oriented development reduces reliance on personal vehicles and minimizes emissions, while green buildings with energy-efficient designs reduce resource consumption. Urban planners are increasingly prioritizing mixed-use developments that reduce the need for long commutes, creating walkable neighborhoods that promote healthier lifestyles and reduce environmental impact. These systems support the sustainable growth of cities by managing resources effectively and creating livable urban environments.

The move toward sustainable infrastructure also has global implications for addressing climate change and meeting international goals such as the United Nations Sustainable Development Goals (SDGs). Infrastructure impacts multiple SDGs, from clean energy and sustainable cities to climate action and responsible consumption. Achieving these goals requires global cooperation, as sustainable

infrastructure projects often involve cross-border investments, knowledge exchange and shared technologies. International collaboration also ensures that developing countries, which may lack resources for sustainable infrastructure, can benefit from financial and technical support, fostering global sustainability and reducing disparities between nations.

Sustainable infrastructure is a multidimensional approach that aligns environmental responsibility, social equity and economic growth. Its focus on resource efficiency, inclusivity, climate resilience and technology integration makes it essential for addressing today's complex challenges and ensuring a sustainable future. Although challenges like high upfront costs and regulatory barriers remain, the long-term benefits make sustainable infrastructure a critical investment. With proper planning, investment and collaboration, sustainable infrastructure can lead to more resilient, equitable and thriving communities worldwide, providing a foundation for sustainable development and progress.

10.2 Infrastructure and sustainable development goals

Similar to the idea of sustainable development, the concept of sustainable infrastructure refers to the ability of infrastructure to meet current needs without compromising the capacity of future generations to fulfill their own needs. Resilience, in turn, describes the capacity of systems, nations, cities, or communities to withstand and recover from challenges arising from natural disasters like floods, droughts, hurricanes, earthquakes and cyclones, as well as from human-induced disruptions.

Thus, the idea of sustainable and resilient infrastructure emerges from these dual pillars of sustainable development and resilience. This framework highlights the essential role infrastructure plays in efforts to mitigate and adapt to the complex challenges of the 21st century, including climate change and various socio-environmental and economic vulnerabilities. Infrastructure is foundational to societal growth and economic advancement in both developed and developing regions. In low-income countries where

adaptation and mitigation resources are limited, climate change can severely impact economic growth, disproportionately affect impoverished communities and intensify challenges for the vulnerable, such as youth, the elderly and those facing poverty or marginalization.

Fig 10.1 illustrates the role of sustainable infrastructure in achieving sustainable development goals (SDGs) across three main areas:

1. Enhancing access to basic services: It aims to alleviate poverty, hunger, ensure health, education, gender equality and clean energy access.

2. Supporting inclusive growth: It promotes economic growth, decent work, reduced inequalities and fosters innovation and resilient infrastructure.

3. Promoting environmental sustainability: It focuses on ecosystem conservation, marine resource sustainability, climate action, sustainable consumption and building resilient cities.



Fig. 10.1. Infrastructure and sustainable development goals
 Source: Ishak, 2018.

Each component aligns with specific SDGs, showcasing infrastructure's impact on various social, economic and environmental dimensions.

Therefore, sustainable and resilient infrastructure is vital for economic growth and social development. It ensures that development benefits reach underserved communities, strengthens governmental capacities to reduce poverty and equips nations with the tools needed to adapt to evolving conditions. Beyond climate-related issues, the urgency of sustainable infrastructure is driven by factors such as population growth, migration and urbanization, particularly in emerging economies. For instance, investments in transportation infrastructure facilitate mobility, link rural economies to broader markets and stimulate economic growth. Similarly, energy infrastructure development is crucial to providing reliable access to electricity in urban and rural areas, powering industry and encouraging diverse investments.

These vital roles make sustainable and resilient infrastructure a key element for achieving the United Nations Sustainable Development Goals (SDGs). This connection is particularly evident in SDG 9, which emphasizes building resilient infrastructure, fostering inclusive and sustainable industrialization and promoting innovation. SDG 9 is a direct call to support sustainable infrastructure, underscoring its importance in realizing the global development agenda. Additionally, infrastructure development is indirectly referenced in several other SDGs.

The first, second, third, fourth, fifth, sixth, seventh, eleventh, twelfth and thirteenth SDGs underscore the role of sustainable infrastructure. For example, SDG 1 emphasizes the eradication of poverty in all forms, including the provision of basic services, resilience to climate change and adaptability to socio-environmental and economic shocks. Continuous infrastructure investment is essential for resilience and the delivery of essential public services, such as education, health, energy, water and sanitation.

SDG 2 calls for ending hunger, achieving food security and promoting sustainable agriculture. Infrastructure investments, particularly in rural areas, are crucial for realizing these goals by

facilitating farmers' access to inputs, extension services and markets, reducing post-harvest losses and supporting market connectivity.

SDGs 3 and 4 address health and education, respectively, underscoring the need for accessible healthcare facilities and educational institutions. For example, health infrastructure such as hospitals and clinics is critical to improving well-being in both urban and rural settings, while educational infrastructure fosters inclusive quality education and enhances urban resilience.

SDG 5 emphasizes gender equality and the empowerment of women and girls, suggesting the necessity of infrastructure for social protection services. Similarly, SDG 6 addresses sustainable water access, which requires infrastructure for water and sanitation. SDGs 7 and 11 highlight the need for energy infrastructure expansion and the creation of sustainable, inclusive cities, focusing on transportation, waste management and climate adaptation strategies.

SDGs 12 and 13, which advocate for sustainable consumption and climate action, also reflect the importance of sustainable infrastructure. SDG 12 emphasizes sustainable procurement for infrastructure projects, while SDG 13 underscores infrastructure's role in mitigating climate impacts. By investing in innovative infrastructure, countries can shield vulnerable communities from climate-related challenges and reduce their exposure to climate risks.

The discussion above underscores that sustainable and resilient infrastructure is a global priority, recognized by governments as crucial for reducing vulnerability and withstanding socio-economic shocks. However, maximizing infrastructure's contribution to sustainability requires the concerted efforts of international bodies, governments, local authorities and the private sector. Collaboration among these groups is essential to ensure that sustainability and resilience principles are fully integrated into infrastructure investments.

The EOSI platform highlights (Table 10.1) the importance of infrastructure for sustainable development across five sectors: Energy, Transport, Water, Solid Waste and Digital Communications. It emphasizes that sustainable infrastructure is key to supporting efficient resource use, reducing environmental impact and enhancing quality of life. Energy infrastructure focuses on renewable sources

and efficiency; transport on reducing emissions and improving connectivity; water on conservation and access; waste on minimizing pollution; and digital communications on bridging the digital divide, all essential for achieving sustainability goals.

Table 10.1. The relationship between infrastructure and Sustainable Development Goals (SDGs)⁶
(based on Song, Wu, 2021)

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
1. End poverty in all its forms everywhere	1.1. By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day					
	1.2. By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	B	B	B	B	B
	1.3. Implement nationally appropriate social protection systems and measures for all, including floors and by 2030 achieve substantial coverage of the poor and the vulnerable		B			B
	1.4. By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance	B	B	B	B	B
	1.5. By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	B	B	A	B	B
	1.a. Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions					
	1.b. Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support					

⁶ The infrastructure influence includes: direct influence (A), indirect influence (B) and irrelevant influence (blank)

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	accelerated investment in poverty eradication actions					
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2.1. By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	B	B	B		
	2.2. By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	B	B	B		
	2.3. By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	B	B			B
	2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	B	B	A	B	B
	2.5. By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed					B
	2.a. Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural					B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	productive capacity in developing countries, in particular least developed countries					
	2.b. Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round					
	2.c. Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility		B			B
3. Ensure healthy lives and promote well-being for all at all ages	3.1. By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	B	B	B		
	3.2. By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births	B	B	B		
	3.3. By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	B	B	B		B
	3.4. By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being	B	B	B		B
	3.5. Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol					B
	3.6. By 2020, halve the number of global deaths and injuries from road traffic accidents		A	B		B
	3.7. By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education and the		B			B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	integration of reproductive health into national strategies and programmes					
	3.8. Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all	B	B			
	3.9. By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination	B	B	B	B	
	3.a. Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate					B
	3.b. Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health and, in particular, provide access to medicines for all	B	B			
	3.c. Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States					B
	3.d. Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks					B
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for	4.1. By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	B	B	B		B
	4.2. By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education	B	B	B		B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
all	4.3. By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	B	B	B		B
	4.4. By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	B	B	B		B
	4.5. By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	B	B	B		
	4.6. By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	B		B		B
	4.7. By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development					
	4.a. Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	B		B	B	B
	4.b. By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries					
	4.c. By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries,					B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	especially least developed countries and small island developing States					
5. Achieve gender equality and empower all women and girls	5.1. End all forms of discrimination against all women and girls everywhere	B		B		
	5.2. Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation	B		B		
	5.3. Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation					
	5.4. Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate	B		B		
	5.5. Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life	B	B	B		
	5.6. Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences		B			
	5.a. Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws					
	5.b. Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women					A
	5.c. Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels					
6. Ensure availability and sustainable	6.1. By 2030, achieve universal and equitable access to safe and affordable drinking water for all	B	B	A		
	6.2. By 2030, achieve access to adequate and equitable sanitation and hygiene for	B	B	A		

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
management of water and sanitation for all	all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations					
	6.3. By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	B		A	A	
	6.4. By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	B		A		
	6.5. By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate			A		
	6.6. By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	B		A		
	6.a. By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies		B			B
	6.b. Support and strengthen the participation of local communities in improving water and sanitation management		B			B
7. Ensure access to affordable, reliable, sustainable and modern energy for all	7.1. By 2030, ensure universal access to affordable, reliable and modern energy services	A	B			
	7.2. By 2030, increase substantially the share of renewable energy in the global energy mix	A				
	7.3. By 2030, double the global rate of improvement in energy efficiency	A	B			
	7.a. By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and					B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	advanced and cleaner fossil-fuel technology and promote investment in energy infrastructure and clean energy technology					
	7.b. By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and land-locked developing countries, in accordance with their respective programmes of support	A				
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	8.1. Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	B	B	B	B	B
	8.2. Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	B	B	B	B	B
	8.3. Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	B	B	B	B	B
	8.4. Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead	B	B	B	B	B
	8.5. By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities and equal pay for work of equal value		B			
	8.6. By 2020, substantially reduce the proportion of youth not in employment, education or training		B			
	8.7. Take immediate and effective measures to eradicate forced labour, end modern					

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers and by 2025 end child labour in all its forms					
	8.8. Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants and those in precarious employment					
	8.9. By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products					
	8.10. Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all					
	8.a. Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries					
	8.b. By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization					
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	9.1. Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all	A	A	A	A	A
	9.2. Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances and double its share in least developed countries	B	B	B	B	B
	9.3. Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit and their integration into value chains and markets		B			B
	9.4. By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean	A	A	A	A	A

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities					
	9.5. Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending					B
	9.a. Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States	A	A	A	A	A
	9.b. Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities	B	B	B	B	B
	9.c. Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020	B				A
10. Reduce inequality within and among countries	10.1. By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	B	B	B	B	B
	10.2. By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status		B	B		B
	10.3. Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard		B	B		B
	10.4. Adopt policies, especially fiscal, wage and social protection policies and progressively achieve greater equality					

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	10.5. Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations					B
	10.6. Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions					
	10.7. Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies					
	10.a. Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements					
	10.b. Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programmes	B	B	B	B	B
	10.c. By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent					B
11. Make cities and human settlements inclusive, resilient and sustainable	11.1. By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	A	A	A	A	A
	11.2. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	B	A			B
	11.3. By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries	B	B	B	B	B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	11.4. Strengthen efforts to protect and safeguard the world's cultural and natural heritage			B		
	11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	B	B	A	B	B
	11.6. By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	A	A	A	A	
	11.7. By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities		B	B	B	
	11.a. Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning	B	B	B	B	B
	11.b. By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels	B	B	A	B	B
	11.c. Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials		B			B
12. Ensure sustainable consumption and production patterns	12.1. Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	B	B	B	A	B
	12.2. By 2030, achieve the sustainable management and efficient use of natural resources	B	B	B	B	B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	12.3. By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	B	B		A	B
	12.4. By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	B	B	A	A	
	12.5. By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	B	B		A	B
	12.6. Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle					
	12.7. Promote public procurement practices that are sustainable, in accordance with national policies and priorities					
	12.8. By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature					B
	12.a. Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production					B
	12.b. Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products					
	12.c. Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities	B				

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
13. Take urgent action to combat climate change and its impacts	13.1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	B	B	A	B	B
	13.2. Integrate climate change measures into national policies, strategies and planning	B	B	B	B	B
	13.3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning		B			B
	13.a. Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible					
	13.b. Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities					B
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development	14.1. By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	B	B	A	A	
	14.2. By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience and take action for their restoration in order to achieve healthy and productive oceans					
	14.3. Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	B				
	14.4. By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as					B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	determined by their biological characteristics					
	14.5. By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information			A		
	14.6. By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation					
	14.7. By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism					
	14.a. Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries					B
	14.b. Provide access for small-scale artisanal fishers to marine resources and markets	B	B			B
	14.c. Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want					
15. Protect, restore and promote	15.1. By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands,	B	B	B	B	

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss	mountains and drylands, in line with obligations under international agreements					
	15.2. By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally	B				
	15.3. By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods and strive to achieve a land degradation-neutral world	B		B		
	15.4. By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development		B			
	15.5. Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species	B				
	15.6. Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed					
	15.7. Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products					B
	15.8. By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species					
	15.9. By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts					
	15.a. Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems					
	15.b. Mobilize significant resources from all sources and at all levels to finance					

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation					
	15.c. Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities					
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	16.1. Significantly reduce all forms of violence and related death rates everywhere	B				
	16.2. End abuse, exploitation, trafficking and all forms of violence against and torture of children					
	16.3. Promote the rule of law at the national and international levels and ensure equal access to justice for all		B			
	16.4. By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime					B
	16.5. Substantially reduce corruption and bribery in all their forms					
	16.6. Develop effective, accountable and transparent institutions at all levels	B	B	B	B	B
	16.7. Ensure responsive, inclusive, participatory and representative decision-making at all levels		B			B
	16.8. Broaden and strengthen the participation of developing countries in the institutions of global governance		B			B
	16.9. By 2030, provide legal identity for all, including birth registration					
	16.10. Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements		B			B
	16.a. Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime					

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	16.b. Promote and enforce non-discriminatory laws and policies for sustainable development					
17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	17.1. Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection					B
	17.2. Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of ODA/GNI to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries					
	17.3. Mobilize additional financial resources for developing countries from multiple sources					
	17.4. Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate and address the external debt of highly indebted poor countries to reduce debt distress					
	17.5. Adopt and implement investment promotion regimes for least developed countries					
	17.6. Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level and through a global technology facilitation mechanism					B
	17.7. Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed	B	B	B	B	B

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	17.8. Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology					A
	17.9. Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation					
	17.10. Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda					
	17.11. Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020		B			B
	17.12. Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries					B
	17.13. Enhance global macroeconomic stability, including through policy coordination and policy coherence					
	17.14. Enhance policy coherence for sustainable development					
	17.15. Respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development					
	17.16. Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries					
	17.17. Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships					

SDGs	SDG targets	Influence				
		Energy	Transport	Water	Solid waste	Digital communications
	17.18. By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts		B			B
	17.19. By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product and support statistical capacity-building in developing countries		B			B

10.3 Green infrastructure: foundations and applications

The world will need an additional 25 million kilometres of roads and 335,000 kilometres of railroads by 2050. Much of it will be built in developing countries with high levels of biodiversity.

Enjoying a glass of water, getting to work or to school, reading a book in the evening. Almost everything we do throughout the day depends on infrastructure. Water pipelines bring potable water to your sink; sidewalks and roads make it easier to travel from one place to another; and energy grids light up your reading nook.

Modern life would not be possible without this built environment. But, its development can interfere with the natural infrastructure that supports all life on the planet.

With a growing and increasingly urban global population, demand for infrastructure development is only increasing. And, infrastructure construction has both direct and indirect impacts on biodiversity. The consequences of increased infrastructure construction can reach farther and last much longer that you might expect. Some effects are clearly visible and easy to predict, while others are less obvious.

Building roads can result in habitat destruction or fragmentation that cuts off critical wildlife migration routes. But a new road might also open up previously inaccessible areas to illicit logging, poaching and other harmful activities. A hydroelectric dam reshapes the landscape in the immediate area, but it may also halt critical water flows to ecosystems and communities thousands of kilometres downriver.

Meeting human needs without damaging biodiversity requires innovative strategies to make infrastructure construction more sustainable. There are many steps governments and developers can take, including:

1. Reduce demand for new infrastructure by increasing efficiencies to make the most of existing facilities.

2. Site selection: avoid locating infrastructure development projects in threatened species habitats and other ecologically sensitive areas.

3. Before construction: conduct rigorous environmental and

social impact assessments that look beyond the immediate area and consider future scenarios.

4. After construction: monitor impacts over time, measuring against clear environmental and social indicators.

5. Invest in renewable energy: it's an opportunity, especially in developing countries where conventional power grids are not fully deployed.

6. Consult the experts: local communities have in-depth knowledge of their areas. They must have an active role in decision-making and their right to free, prior and informed consent (FPIC) must be respected.

Green infrastructure, an approach that integrates natural and semi-natural systems into urban and regional planning, is increasingly valued for its multifaceted benefits that extend far beyond traditional infrastructure approaches. Unlike gray infrastructure, which primarily focuses on engineered solutions for tasks such as stormwater management and transportation, green infrastructure incorporates elements such as parks, green roofs, rain gardens and permeable surfaces to address similar challenges while simultaneously offering a host of environmental, economic and social advantages.

A core benefit of green infrastructure lies in its capacity to improve environmental quality in urban areas, where population density and development often lead to higher pollution levels. Urbanization typically transforms land into impermeable surfaces, causing rainwater to flow quickly into storm drains rather than seeping into the ground. This runoff not only erodes soil and carries pollutants into rivers and streams but also puts pressure on urban water systems, increasing the risk of flooding. Green infrastructure, however, uses permeable surfaces, vegetation and soil to absorb rainwater, filter pollutants and replenish groundwater reserves. This approach not only reduces urban flooding but also improves water quality, which is crucial for maintaining healthy aquatic ecosystems. Furthermore, green infrastructure helps in the sequestration of carbon, reducing the amount of CO₂ in the atmosphere – a particularly valuable function given the accelerating challenges posed by climate change.

In addition to its ecological benefits, green infrastructure can be economically advantageous for communities. Although the initial investment in green infrastructure can sometimes be higher than conventional alternatives, these costs are often offset by long-term savings. By reducing the load on traditional stormwater and sewage systems, green infrastructure helps to lower maintenance and repair costs. Vegetated areas such as parks and greenways also increase property values in surrounding neighborhoods, attracting investment and generating additional tax revenue for municipalities. Moreover, the increased tourism and business opportunities that green spaces attract further stimulate local economies. In the long term, green infrastructure can even help to insulate cities from the financial impacts of climate-related disasters, such as floods and extreme heat events, by providing natural buffers and enhancing climate resilience.

Beyond the environmental and economic benefits, green infrastructure contributes significantly to public health and well-being. Urban green spaces are known to have a positive impact on mental health, reducing stress and improving mood. Access to green spaces has been linked to lower levels of depression, anxiety and cardiovascular disease, as people who spend more time in nature tend to exhibit better overall physical and mental health. Green infrastructure also encourages physical activity by providing accessible, appealing outdoor areas for exercise and recreation. Improved air quality is another health benefit of green infrastructure; plants and trees absorb pollutants such as carbon monoxide, sulfur dioxide and nitrogen dioxide, making the air cleaner and reducing respiratory issues among urban residents. This function is especially important in densely populated areas where air quality is often compromised by vehicle emissions and industrial activity.

Social cohesion and community identity are also strengthened through green infrastructure. Parks, trails and community gardens serve as gathering spaces that bring people together and foster social interactions. When people feel connected to their surroundings, they develop a stronger sense of place and are more likely to engage in community activities and take pride in their neighborhoods. Community-based green infrastructure projects, such as rain gardens

or urban farms, allow residents to collaborate in the design, construction and maintenance of these spaces, further strengthening social bonds. Green spaces also play a role in cultural preservation and education by offering venues for events, arts and environmental education programs, all of which foster a deeper connection to the natural environment and local culture.

Furthermore, green infrastructure enhances urban aesthetics, creating visually pleasing landscapes that offer a reprieve from the concrete and steel of modern cities. This can greatly improve quality of life, especially in areas where access to nature is limited. The aesthetic value of green infrastructure has an impact on urban vitality and tourism, drawing people to neighborhoods with attractive, sustainable landscapes. Architectural elements like green roofs and living walls not only add visual interest but also represent a new way of reimagining the relationship between the built and natural environments. These features enhance biodiversity by providing habitats for birds, insects and other wildlife, bringing a sense of the natural world into urban settings.

In addition to making conventional infrastructure more eco-conscious, many city planners are recognizing the potential of ‘blue-green infrastructure’ to better serve their communities. Green infrastructure includes planting trees on city streets, which improves air quality by reducing surface-level ozone and other pollutants. Blue infrastructure includes measures like restoring wetlands to store and filter water and reduce the need for more floodwalls and water treatment plants. Going green – or blue – can also mean engineering ‘grey’ infrastructure to mimic natural processes. For instance, making pavements permeable allows them to absorb rainwater much like soil would do, reducing the risk of flood, sewer overflows and water pollution.

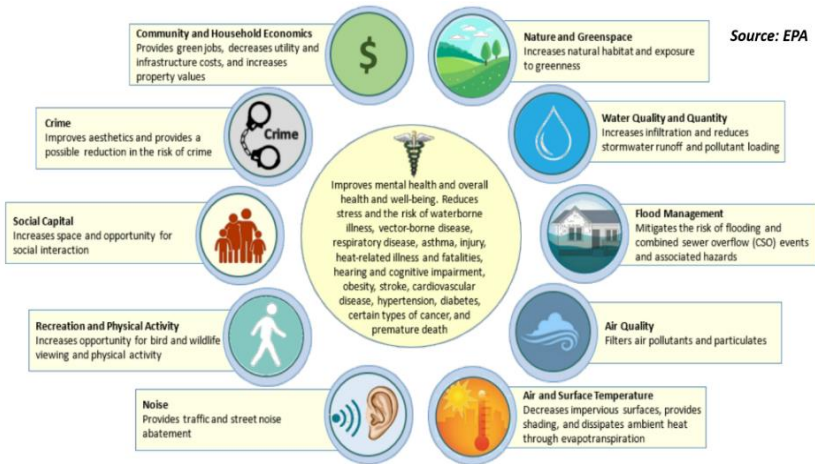


Fig. 10.3. Benefits of green infrastructure
 (Infrastructure: Public works for people and planet)
 Healthy Benefits of Green Infrastructure in Communities

The benefits of green infrastructure go beyond its immediate functionality. Planting trees on city streets improves air quality by reducing surface-level ozone and other pollutants. Green spaces in urban areas provide room for wildlife while improving livability for people by increasing space for recreation and opportunities to encounter nature.

Infrastructure supports healthy communities, economic activity and job creation. It connects us to each other and to distant places. But poorly conceived infrastructure can produce the opposite effects in the long term by undermining the natural infrastructure that healthy ecosystems provide. A mix of green infrastructure and well-designed grey infrastructure can provide for the needs of societies while maintaining a healthy environment.

Integration of green infrastructure offers a comprehensive suite of benefits that bolster environmental resilience, strengthen local economies and improve public health and social well-being. By combining ecological function with urban design, green infrastructure serves as a dynamic, sustainable approach to infrastructure that aligns with the needs of contemporary society. As

communities and policymakers increasingly recognize the importance of these systems, green infrastructure stands as a vital tool for addressing urban challenges in a holistic and enduring manner.

10.4 Sustainable and resilient infrastructure as applied approach for policy

Sustainable and resilient infrastructure is increasingly recognized as vital to addressing global challenges such as climate change, rapid urbanization and socio-economic inequalities. Infrastructure lies at the heart of human development, facilitating essential services like transportation, energy, water and sanitation, while also shaping our interactions with the environment and economy. Sustainable infrastructure focuses on minimizing environmental impact, conserving resources and ensuring long-term viability, while resilience emphasizes the ability of infrastructure systems to withstand, adapt to and recover from disruptive events. Both dimensions – sustainability and resilience, are integral to creating infrastructure systems that not only meet current needs but also safeguard future generations.

At the core of sustainable infrastructure is a commitment to environmental stewardship. Traditional infrastructure development has often prioritized economic growth at the expense of ecological balance, leading to resource depletion, pollution and biodiversity loss. Sustainable infrastructure seeks to counter these effects by integrating environmentally friendly practices throughout the project lifecycle, from design and construction to maintenance and eventual decommissioning. For instance, green building practices encourage the use of sustainable materials, energy-efficient designs and renewable energy sources, reducing both the ecological footprint of buildings and their operational costs. Similarly, sustainable transportation infrastructure, such as public transit systems and cycling networks, promotes low-emission alternatives to car dependency, helping to reduce air pollution and mitigate climate change. By prioritizing sustainability, infrastructure projects can not

only minimize environmental degradation but also contribute to healthier, more livable communities.

Resilient infrastructure, on the other hand, emphasizes adaptability in the face of both anticipated and unforeseen challenges. Natural disasters, such as hurricanes, floods and earthquakes, are becoming more frequent and intense due to climate change, placing increased stress on infrastructure systems. In response, resilient infrastructure is designed to endure these shocks and bounce back with minimal disruption to essential services. For example, coastal cities facing rising sea levels are investing in seawalls, flood barriers and elevated infrastructure to mitigate the risk of flooding. In earthquake-prone regions, infrastructure is being retrofitted with shock-absorbing materials and flexible designs that can withstand seismic activity. By integrating resilience into infrastructure planning, communities are better equipped to maintain continuity of services, protect lives and avoid costly repairs or replacements in the aftermath of disasters.

Sustainable and resilient infrastructure also plays a critical role in supporting economic development and social equity. In many parts of the world, inadequate infrastructure remains a significant barrier to economic growth and poverty alleviation. By investing in sustainable infrastructure, governments and organizations can create jobs, boost productivity and promote inclusive economic development. For instance, renewable energy projects not only reduce greenhouse gas emissions but also provide employment opportunities, particularly in remote or underserved areas. Similarly, resilient infrastructure helps prevent the disproportionate impacts of climate change on vulnerable communities, who are often the least equipped to cope with disruptions to essential services. By ensuring that infrastructure serves all members of society equitably, sustainable and resilient projects can foster social cohesion and improve quality of life for marginalized populations.

The financial dimension of sustainable and resilient infrastructure is another crucial consideration. Although the upfront costs of sustainable and resilient infrastructure can be higher than traditional options, these investments often yield substantial long-term savings. Energy-efficient buildings, for instance, may cost more

to construct but offer significant reductions in energy bills over time. Similarly, resilient infrastructure can prevent the economic losses associated with disaster recovery, which can be exponentially higher than the initial investment in protective measures. To encourage such investments, innovative financing mechanisms, including green bonds, public-private partnerships and international funding from institutions like the World Bank and the United Nations, have been developed. These financing options help bridge the gap between short-term costs and long-term benefits, making sustainable and resilient infrastructure more accessible to governments and communities worldwide.

Policy and regulatory frameworks also play a fundamental role in promoting sustainable and resilient infrastructure. National governments, regional authorities and international organizations are increasingly adopting policies that mandate environmental and resilience considerations in infrastructure development. For instance, building codes and zoning laws can require the incorporation of climate-resilient designs, while environmental regulations can limit the impact of infrastructure projects on ecosystems and natural resources. International agreements, such as the Paris Agreement on climate change and the United Nations Sustainable Development Goals, further emphasize the importance of sustainable infrastructure as a means of achieving global environmental and development objectives. By setting clear standards and guidelines, these frameworks provide a foundation for infrastructure projects that align with broader sustainability and resilience goals.

Technological innovation is another key driver in the evolution of sustainable and resilient infrastructure. Advances in digital technologies, such as the Internet of Things (IoT), big data analytics and artificial intelligence, are enabling smarter and more efficient infrastructure systems. For instance, smart grids allow for the dynamic distribution of electricity, optimizing energy use and reducing waste. Similarly, IoT sensors can monitor infrastructure conditions in real-time, detecting potential vulnerabilities and enabling preventive maintenance. In the context of transportation, autonomous vehicles and intelligent traffic management systems can enhance safety and efficiency, reducing both congestion and

emissions. By integrating these technologies, infrastructure systems can be more responsive to changing conditions, improving both their sustainability and resilience.

Education and public awareness are also vital to the successful implementation of sustainable and resilient infrastructure. Infrastructure projects often involve complex technical and financial considerations that require a high degree of expertise. However, community engagement and public support are equally important, as infrastructure decisions have significant impacts on local populations. By raising awareness about the benefits of sustainable and resilient infrastructure, governments and organizations can build public support for these projects and encourage responsible behavior among citizens. Educational initiatives, such as public workshops, school programs and media campaigns, can help communities understand the importance of sustainability and resilience in infrastructure and encourage active participation in decision-making processes.

The challenges to achieving sustainable and resilient infrastructure are considerable. Many regions, particularly in developing countries, face significant resource constraints, limiting their capacity to invest in sustainable and resilient solutions. Moreover, the impacts of climate change and environmental degradation are often most severe in areas with the least capacity to adapt, creating a vicious cycle of vulnerability and underdevelopment. In addition, political and institutional barriers, such as short-term planning horizons, inadequate regulatory frameworks and a lack of coordination among stakeholders, can hinder the implementation of sustainable and resilient infrastructure projects. Overcoming these challenges requires a concerted effort from governments, private sector partners, international organizations and civil society, each playing a distinct yet complementary role in fostering sustainable and resilient development.

Launched at the UN Climate Change Conference (COP 21) in 2015, the SuRe Standard is a voluntary, independently verified instrument to help developers integrate sustainability and resilience into infrastructure projects. SuRe aims to deliver better quality

infrastructure and contribute to the achievement of international frameworks, including the Sustainable Development Goals and the Convention on Biological Diversity.

The Standard for Sustainable and Resilient infrastructure is based on such points:

What:

- A global voluntary standard which integrates sustainability and resilience aspects into infrastructure development and upgrade.

Why:

- Establish a common language and understanding between project developers, financiers and public sector institutions around sustainable and resilient infrastructure;

- Improve the attractiveness of sustainable and resilient infrastructure to multilateral and private investors, therefore channeling greater financing flows;

Characteristics:

- relies on independent verification and certification of infrastructure projects throughout their life cycles – Applicable to infrastructure projects across sectors in developed, emerging and developing countries;

- applicable during design, construction and operation phases;

- relevant to three main groups of stakeholders i.e. project developers, financiers and public sector institutions.

The SuRe® (Sustainable and Resilient Infrastructure) standard is a transformative framework that integrates sustainability and resilience into infrastructure projects, ensuring they contribute to the broader resilience needs of the regions where they are implemented. By emphasizing proactive measures, such as vulnerability assessments and participatory stress testing, SuRe® enables projects to prepare for and withstand potential disruptions, whether environmental, social, or economic. The standard aligns closely with the targets of the Sendai Framework for Disaster Risk Reduction, enhancing the resilience of communities and contributing to the achievement of global disaster risk reduction goals.

A core component of SuRe® is its focus on resilience, which is evident in its specific criteria. Approximately half of SuRe®'s guidelines are dedicated to resilience planning, addressing both

immediate and long-term threats that infrastructure projects may face. For instance, Resilience Planning requires projects to consider potential vulnerabilities and incorporate strategies to strengthen the adaptability and robustness of the infrastructure. This proactive approach is essential in a world where climate change and environmental degradation are increasingly causing extreme weather events and natural disasters. Through resilience planning, infrastructure projects are designed not only to serve their primary function but to remain operational and beneficial even under adverse conditions.

Emergency Preparedness is another critical component within the SuRe® framework. This criterion ensures that infrastructure projects are equipped to handle emergencies effectively, minimizing disruption to essential services. Emergency preparedness involves designing infrastructure that can accommodate evacuation plans, emergency supply routes and response mechanisms that protect both the physical infrastructure and the surrounding population. This criterion goes hand in hand with Risk Management, which requires projects to assess and mitigate potential risks, whether they stem from natural disasters, technological hazards, or socio-political instability. By fostering a culture of risk awareness, SuRe® enables infrastructure projects to better anticipate, prepare for and respond to unexpected challenges, thus safeguarding community resilience.

In addition to addressing physical threats, SuRe® places significant emphasis on human health and safety through its Occupational Health and Safety and Public Health and Safety criteria. These guidelines ensure that projects prioritize the well-being of both workers and the communities served by the infrastructure. For example, occupational health and safety measures ensure safe working conditions for those involved in construction and maintenance, reducing the likelihood of workplace accidents and injuries. Public health and safety considerations further ensure that infrastructure projects do not pose environmental health risks, such as contamination or pollution, to surrounding areas. These criteria demonstrate SuRe®'s commitment to holistic resilience, where human well-being is central to infrastructure planning and development.

An often-overlooked aspect of resilience is the interconnectivity and integration of infrastructure systems, addressed by the Infrastructure Interconnectivity and Integration criterion. This criterion encourages projects to consider how infrastructure networks interact and support one another, creating a more cohesive and resilient overall system. For instance, an integrated approach to transportation, energy and water infrastructure can provide backup solutions during a crisis. A failure in one system can be mitigated by the support of interconnected systems, allowing communities to retain access to critical resources and services. By promoting interconnectivity, SuRe® encourages infrastructure designs that are not only resilient in isolation but part of a larger network capable of mutual support.

Finally, SuRe® directly addresses one of the most pressing global issues – Climate Change Adaptation. As climate change accelerates, infrastructure projects must be designed with future climate conditions in mind. This criterion encourages projects to adopt adaptive strategies, such as building flood-resistant structures or using materials that can withstand temperature extremes. By incorporating climate change adaptation into infrastructure planning, SuRe® ensures that projects are not only resilient today but will continue to function in a changing climate, thus extending their lifespan and maximizing their long-term value to society.

In conclusion, the SuRe® standard is more than a guideline for sustainable infrastructure; it is a comprehensive framework that ensures projects contribute to the resilience of the communities they serve. By integrating criteria focused on resilience planning, emergency preparedness, risk management, health and safety, interconnectivity and climate change adaptation, SuRe® aligns with global frameworks like the Sendai Framework, actively working to reduce disaster risks and enhance the resilience of infrastructure. Through these efforts, SuRe® helps build infrastructure that is not only functional but robust, adaptable and capable of supporting sustainable development even in the face of adversity.

Fig. 10.4 illustrates the SuRe® (Sustainable and Resilient Infrastructure) Standard’s framework for guiding infrastructure projects to create positive social, environmental and economic

impacts. It follows a flow from "Input" through "Activities," "Outputs," and finally to "Impact," showcasing how sustainable infrastructure projects can drive progress on global challenges, especially those identified in the United Nations Sustainable Development Goals (SDGs). The SuRe® Standard helps projects mitigate risks, maximize service delivery and address critical global issues through quality infrastructure. Here's a deeper look at each stage and its significance.



Fig. 10.4. Sustainable and Resilient Infrastructure Standard’s framework for guiding infrastructure projects to create positive social, environmental and economic impacts

At the initial «Input» stage, the SuRe® Standard provides a foundational guideline for projects. This stage involves the adoption of practices designed to reduce environmental risks and improve service efficiency. Infrastructure projects often face numerous risks,

such as climate impacts, resource depletion and social inequalities. By following the SuRe® Standard, projects can better assess and mitigate these risks, positioning themselves to benefit both society and the environment. For instance, the SuRe® Standard encourages water conservation, efficient energy use and effective waste management, all of which contribute to reducing environmental degradation.

In the «Activities» stage, the SuRe® Standard directs projects to actively integrate specific SDGs, as depicted in the figure. These include SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 17 (Partnerships for the Goals), SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action). By aligning with these goals, infrastructure projects not only improve their sustainability and resilience but also create tangible benefits for communities. Clean water initiatives (SDG 6) and renewable energy (SDG 7) reduce health risks and environmental impacts, while promoting access to essential resources. Additionally, aligning with SDG 8 fosters employment opportunities, especially when infrastructure projects create new jobs and promote fair labor practices. The focus on SDG 17, which advocates partnerships, highlights the importance of collaboration among governments, private entities and communities to achieve sustainability goals. SDGs 12 and 13 ensure that infrastructure projects adopt responsible consumption practices and are prepared to adapt to the challenges posed by climate change.

The next stage, labeled as «Outputs» refers to the tangible results of implementing sustainable practices. The SuRe® Standard aims to produce infrastructure of higher quality, combining functionality with environmental and social considerations. Here, SDG 9 (Industry, Innovation and Infrastructure) plays a pivotal role, as it emphasizes the development of resilient infrastructure that supports inclusive and sustainable industrialization. The SuRe® certification further affirms the quality and sustainability of these projects, serving as a seal of credibility for investors, policymakers and the public. Achieving such outputs requires careful planning, innovative design and the integration of advanced technologies. For

instance, using IoT (Internet of Things) sensors to monitor infrastructure health or implementing green construction materials can enhance both the durability and sustainability of projects, resulting in robust infrastructure that is better suited to withstand environmental stresses.

Following «Outputs» the «Outcome» stage broadens the impact of quality infrastructure by addressing a wider range of SDGs. Here, the focus shifts to improving public health (SDG 3), education (SDG 4), sustainable urban development (SDG 11), aquatic and terrestrial ecosystem health (SDGs 14 and 15), peace and justice (SDG 16) and gender equality (SDG 5). By delivering high-quality infrastructure, projects can positively influence these areas, creating healthier, safer and more inclusive communities. For example, improved water and sanitation facilities contribute to public health outcomes by reducing disease prevalence (SDG 3), while accessible transportation networks help reduce social disparities, giving communities better access to educational and economic opportunities (SDG 4). Sustainable cities and communities (SDG 11) become a reality as well-planned infrastructure supports urban growth while protecting green spaces and reducing pollution. Additionally, inclusive infrastructure projects can promote social equity, supporting gender equality (SDG 5) and fostering community engagement in decision-making processes, thereby contributing to peace and justice (SDG 16). In this stage, the infrastructure does not simply serve its immediate function; it becomes a catalyst for broader social and environmental progress.

Finally, the «Impact» stage represents the most profound, lasting effects of sustainable infrastructure, including poverty reduction (SDG 1), zero hunger (SDG 2) and reduced inequalities (SDG 10). These long-term impacts align with some of the most challenging global issues, highlighting the transformative power of resilient and sustainable infrastructure. By reducing vulnerabilities to climate change, disasters and resource scarcity, sustainable infrastructure helps communities escape cycles of poverty (SDG 1). Access to clean water and sanitation, for example, reduces healthcare costs and frees up time that individuals – especially women and children – can spend on education or economic activities. Similarly,

infrastructure that supports agricultural productivity, such as irrigation systems or supply chains, contributes to food security and alleviates hunger (SDG 2). The focus on reducing inequalities (SDG 10) is especially important, as resilient infrastructure often benefits the most vulnerable populations, providing them with access to basic services and opportunities for upward mobility.

Overall, the SuRe® Standard's framework demonstrates a comprehensive approach to infrastructure development that is aligned with global sustainability goals. The figure reflects a step-by-step journey, from risk mitigation and quality improvement to societal impact, underscoring the importance of infrastructure as more than a means to economic growth. It is a tool for fostering social justice, environmental protection and sustainable development on a global scale. The alignment with specific SDGs in each phase underscores the interconnectedness of these goals, showing how targeted actions in one area can produce ripple effects that advance other objectives. This holistic approach challenges traditional notions of infrastructure as static physical assets, redefining it as an active, evolving part of our collective progress toward a sustainable future.

SuRe® Standard offers a pathway for infrastructure projects to contribute to sustainable development and resilience through each stage of their lifecycle. By following the framework depicted in the figure, infrastructure projects are positioned to deliver substantial benefits, not only meeting the immediate needs of communities but also addressing some of the most difficult global challenges. Through the adoption of best practices in environmental sustainability, social responsibility and risk management, infrastructure can drive progress across multiple SDGs, creating a legacy of positive impact for generations to come. This approach holds significant promise for achieving a balance between development and sustainability, ensuring that infrastructure serves as a foundation for human well-being, economic opportunity and ecological harmony.

Sustainable and resilient infrastructure is essential to creating a more equitable, healthy and prosperous world. By integrating environmental stewardship and adaptability into infrastructure planning, we can build systems that support human development

without compromising ecological integrity. Sustainable infrastructure minimizes resource consumption and reduces environmental impact, while resilient infrastructure ensures the continuity of services amid disruptions. Together, these approaches offer a pathway to infrastructure systems that are both forward-looking and responsive to the complex challenges of the 21st century. As global leaders, policymakers and communities continue to recognize the importance of sustainable and resilient infrastructure, a transformation in the way we build and maintain our infrastructure is not only possible but imperative. This transformation will require innovative technologies, progressive policies and a commitment to long-term thinking, but the rewards, a safer, more sustainable and more resilient world, are well worth the effort.

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11. PRACTICAL RECOMMENDATIONS FOR THE FORMATION OF SERVICE (SOFT) INFRASTRUCTURE IN LOCAL COMMUNITIES UNDER CONDITIONS OF POST- WAR RECOVERY

11.1 The essence of public services and the subjects of their provision and receipt within the framework of the formation of service (soft) infrastructure

Under war conditions in Ukraine, implementing most reforms and revolutionary achievements by traditional means is impossible. Due to military actions by the Russian Federation, the expected qualitative and quantitative results of the planned changes – reforms for joining the European Community as a worthy competitive partner – are unattainable. In these conditions, there is a need to apply new approaches to forming a strategy for the further development of the country as a whole and its territorial communities as individual units of the implementation of prospective development plans. However, it should be noted that this, in turn, actualizes the problem of developing recommendations that would satisfy not only the current needs of territorial communities but also those that would be directed to the long-term perspective for their development and Ukraine as a whole. Programs for the post-war reconstruction of the territories of Ukraine are a priority issue. However, current realities indicate local self-government bodies lack experience in solving these issues. World experience proves that the most promising direction is the formation of innovative communities within a specific territorial community, which provides for an effective relationship and cooperation of three branches: government, business and population. At works (Illiashenko, 2023; Illiashenko, Myronenko, 2023), we already emphasized the options for such collaboration and their benefits. One relevant issue is the adequate provision of public services by local self-government bodies to the subjects of their receipt in the conditions of post-war recovery. So, let's dwell on

solving this problem in more detail.

First, developing recovery programs is not mandatory for communities' further functioning and development. This is because not all communities undergo significant changes in their activities in war conditions and do not need the development of recovery projects. This applies to communities where active hostilities are not taking place. At the same time, it should be noted that without this, communities do not have the right to additional funding for their further development. For example, they will not be able to apply for financing from the State budget for the design, restoration, construction, modernization, arrangement, or repair of construction objects of public purpose, social sphere, cultural heritage, housing, and communal services, other objects that have an impact on life activities of the population (by the resolution of the CMU No. 608 of June 16, 2023). Without additional infusions into the budget, in most cases, territorial communities do not have the opportunity for full-fledged development, including post-war recovery (Duginets, Kolodko, 2023).

At the same time, a mandatory condition for all local self-government bodies is the formation and implementation of the Community Development Strategy – by Article 7 of the Law of Ukraine "On the Basics of State Regional Policy", which provides for the formation of a comprehensive system of strategic planning, which includes: State Strategy regional development of Ukraine, regional development strategies and development strategies of territorial communities.

In addition, for Ukraine to become a member of the European Union as a worthy partner, it must meet the requirements set out in European legislation. For this, a necessary condition is the development of appropriate strategies and programs for further growth based on EU initiatives.

Finally, it should be noted that the need to develop and implement programs for the post-war recovery of territorial communities of Ukraine is confirmed by the fact that any development strategies should aim to meet the needs and demands of the population living within the given region. Today, most communities that actively participate in hostilities need an end to

military operations as soon as possible and further post-war reconstruction. After all, without this, additional economic development of these territorial communities will not take place in general.

In Ukraine, several legislative acts regulate the provision of public services. The most significant is the Law of Ukraine "On Peculiarities of Providing Public (Electronic Public) Services". According to it, a public service is a legally or socially significant action of the subject of providing a public (electronic public) service, including an administrative service, at the request (appeal, request) of the subject of the appeal or without such an appeal, as a result of which they are transferred, the rights and/or duties of the subject of the appeal are terminated, the corresponding material and/or immaterial goods are provided to the subject of the appeal. As seen from this definition and the law, service (soft) infrastructure formation is currently offered at the legislative framework level. After all, the digitalization of the sphere of public services is one of the main aspects of the service infrastructure.

As for the subjects of the provision of public services, they include: state authorities, local self-government bodies, their officials, state and communal enterprises, institutions, organizations and other subjects authorized by law to provide public (electronic public) services (Kovalenko, Dunayev, 2023).

In turn, subjects receiving public services are citizens of Ukraine who live within a particular territory (territorial community), stateless persons residing within a specific territory, and natural and legal persons who own real estate within a specific territory or are within a particular territory on legal grounds (Pokotylo, Berezin, 2024; Orel, Kulinich, 2023).

In general, it should be noted that the primary purpose of providing public services is to satisfy the needs and requests of subjects receiving public services. It should be considered that within a specific territory, public service entities must provide access to all essential services (Fig. 11.1). So, the essential complex includes:

1. Administrative services – all services related to administrative activities provided by the community administration.
2. Community services – are aimed at improving the quality of

life of the territory's residents and are intangible. Healthcare institutions, education, culture, social assistance, etc, provide it.

3. Technical services – are aimed at maintaining and developing the state of the technical infrastructure of the territory: roads, water supply systems, electricity and heat supply, communal transport, garbage removal, etc.

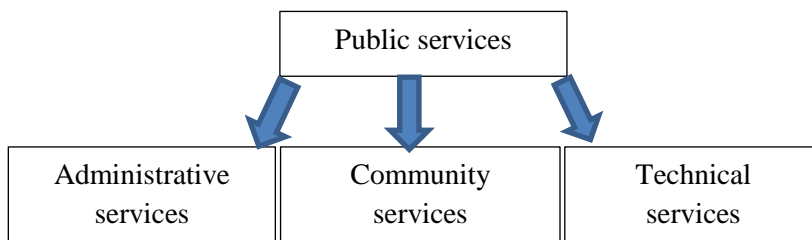


Fig. 11.1. The essential complex of public services
Source: developed by the authors

It should be noted that within the framework of the creation of service (soft) infrastructure, the most common technology today is the capabilities of the Internet network (Aboushala, Haj Ismail, 2022; Sánchez-Zamora, Gallardo-Cobos, 2019). And in this aspect, we are talking about introducing electronic governance.

Electronic governance organizes state power using systems of local information networks and segments of the global information network. This ensures the functioning of authorities in real-time and makes daily communication with them as simple and accessible as possible for citizens, legal entities, and non-governmental organizations.

In general, this technology involves several alternating tasks (Moe, Geis, 2020; Ikpe, 2021):

- use of Internet capabilities by authorities (websites of administrations, pages in social networks, etc.);
- provision of information with the possibility of searching by databases and service of answers to links by e-mail;
- provision by authorities of interactive services that allow citizens, by visiting the relevant official website, to fill out various

forms, forms, ask questions, schedule meetings, look for work, etc.;

–the possibility of obtaining administrative services via the Internet: obtaining licenses, permits, submitting tax returns, paying fines, applying for social benefits, etc. This, in turn, requires increasing the security of the "e-government" infrastructure, which can, as a rule, be achieved by using electronic signatures and certificates, as well as intelligent cards;

–authorities can create unique web portals that would allow citizens to move from one service to another without having to prove their identity again;

–electronic voting (conducting elections, population surveys, and identifying public opinion).

Having chosen a pro-European vector of development, Ukraine should join all the European Union initiatives. Since then, the EU has compiled and described 20 types of services that must be implemented digitally (Fig. 11.2). This is an EU directive and must be followed by all countries.

Today, there are already examples of successful implementation of electronic governance in Ukraine (Brenner, 2023). So, for example, an urgent issue of solving the problem of the provision of administrative services in territorial communities where hostilities are taking place is the work of mobile Centers for the provision of administrative services (CPAP), which involves the departure of employees to the place of application (Wang, 2022). A more practical option is the creation of digital CPAPs (for example, based on <https://center.dii.gov.ua/centr-dii>), with the help of which you can quickly and conveniently receive the relevant administrative services.

Separately, it is worth noting that the Ministry of Digital Transformation of Ukraine aims to ensure that by 2024, the entire range of public services is available to citizens and businesses online. It is also assumed that an intermediary should be provided for those citizens who are currently unable (due to their knowledge and skills or lack of access to digital receipt of services) to use such opportunities. The so-called "digital administrator" who, upon appropriate request, will help obtain a digital service (Waheduzzaman, 2019).

In general, the main components of electronic governance include (Solvak, 2019; Cordella, 2019):

1. E-medicine. This includes:

–Electronic medical records – contain an electronic medium that will store the patient's medical history, information about vaccinations, and his desire to become a donor;

–Electronic prescription: electronic access to making or changing prescriptions, printing prescriptions for patients, and sometimes electronic transmission of prescriptions from doctors to pharmacists;

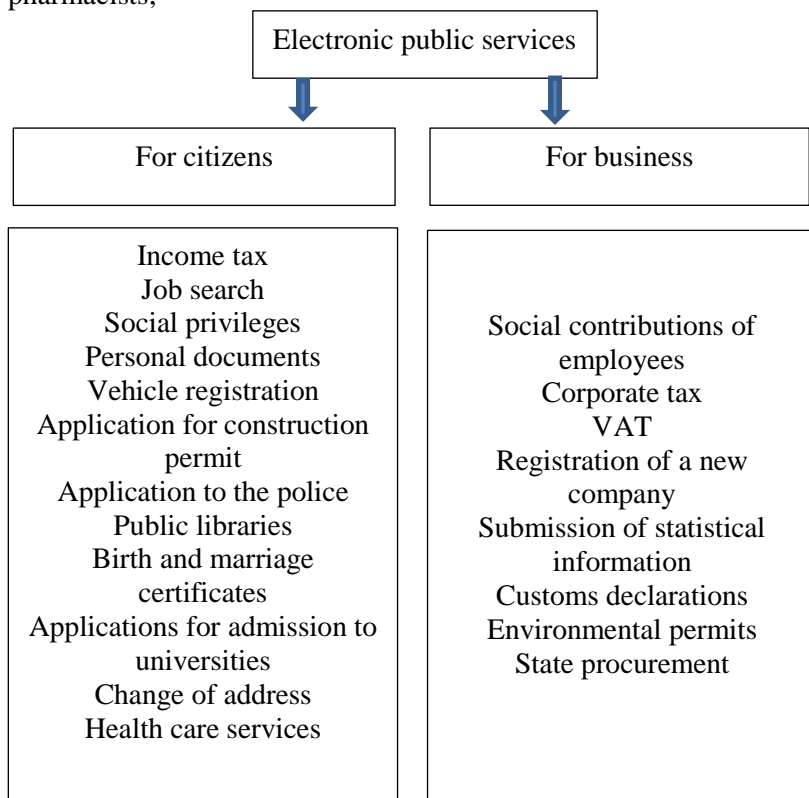


Fig. 11.2. The essential complex of electronic public services
 Source: developed by the authors

–Telemedicine: physical and psychological methods of treatment at a distance, including telemonitoring of patients' condition;

–Informing the population: using electronic resources on medical topics to inform patients to ensure public awareness of health issues (for example, during epidemics);

–Virtual medical teams: consist of medical professionals who collaborate and share information about patients using digital equipment (e.g., web conferencing);

–Mobile medicine: includes the use of mobile devices to collect data about the physical or psychological state of the patient, which are transmitted to doctors or researchers, as well as monitoring the patient's vital organs in real-time, direct care (using mobile telemedicine) (using mobile phone for blood pressure measurement, blood test for diabetes, etc.);

–Medical information systems: specialized programs for planning patient appointment schedules, patient data management, work schedule management, and other administrative tasks related to the organization of health care.

–Development of one's diet: modern methods of diagnosis, monitoring (control and self-control), and assessment of the state of human health, which help to determine changes in the state of the body depending on certain external and internal factors.

2. E-telephony. We are conducting meetings and discussions and making management decisions using mobile devices.

3. E-legislation. Free access to legislative documents at all stages of the law-making process.

4. E-employment. Refers to one of the 20 digital services in the European Union directive. Today, private job search sites such as work.ua, for example, are more prevalent in Ukraine. However, in recent years, decent platforms for finding work in the field of public administration have also appeared. From this, you can find existing vacancies in state authorities, review their requirements, participate in competitions for positions, use online resources to prepare for the competitive procedure, etc.

5. E-education. This is a form of education obtained using exclusively information and communication technologies. An

example of obtaining electronic informal education in Ukraine is the public project of mass open online courses "Prometheus" (<https://prometheus.org.ua/>). As part of this project, an online platform was created with free online courses that anyone can study and receive a certificate of completion.

More interesting for public sector managers is the block "Civic Education", which presents such courses as: "Fundamentals of Love", "Fundamentals of State Policy", "Fighting Corruption", "Urban Planning: Modern City", "Economics for All", etc.

6. E-libraries. The European Union directive on digital services also includes electronic public libraries. In addition, transferring the library fund into a digital format allows them to significantly expand their target audience and increase the interest of various population segments.

7. E-bank. Today, all state banks have their own websites and electronic banking systems. After the nationalization of "PrivatBank", the state received one of the best systems in the world of the Internet bank "Privat 24".

8. E-democracy. It is a form of democracy characterized by the use of information and communication technologies (ICT) as the primary means for collective mental (crowdsourcing) and administrative processes (informing, making joint decisions – electronic voting, monitoring the implementation of decisions, etc.) at all levels – starting from the level of local self-government to the international level.

The Recommendations of the Council of Europe on e-democracy define the following sectors or areas of e-democracy:

–E-parliament – the use of ICT by the parliament, parliamentarians, and administrative staff to perform their tasks, mainly to engage citizens. Electronic parliamentarian involves many interested parties (stakeholders): members of parliament, administrative staff, voters, citizens, and the media. The e-parliament also uses other sectors of e-democracy: e-legislation, e-voting, e-petitions, and e-consultations.

–E-legislation – the use of ICT for drafting bills, commenting, consulting, structuring, formatting, presenting, and amending. E-legislation makes the legislative process more transparent, allows for

the improvement of the content of legislation, and provides better access to legislation and public competence in the field of legislation.

–E-justice – the use of ICT for the administration of justice by all participants in the process, improving the quality of court services for citizens and businesses. It includes electronic communication data exchange and access to judicial information. The justice system improves based on better access to justice for citizens.

–E-mediation – using ICT to resolve disputes without the parties' physical presence. E-tools are intermediaries.

–E-environment – use of ICT for environmental assessment and protection, spatial development planning, sustainable and safe use of natural resources based on citizen participation in decision-making.

–E-elections, e-referendums, e-initiatives – involve using ICT in the specified political measures at one or more stages of their implementation.

–E-voting – involves using ICT in elections or referenda, at least for counting votes.

–E-consultation is an electronic way of collecting data on the opinions/positions of specific stakeholders and the public regarding certain public policy issues. The consultation does not imply the obligation of the responsible person to decide the recommended way. There are many forms of e-consultation: formal/informal, regulated by the public or government, unregulated, etc.

–E-initiatives – allow citizens to express their proposals using ICT and thus influence the formation of the public policy agenda.

–E-petitions – use of ICT to submit protests and recommendations to democratic institutions. Citizens sign petitions and join the discussion by entering their names and addresses online. There are various forms of e-petitions.

–E-political campaigns – the use of ICT to encourage citizens to participate in electoral or other political campaigns aimed directly or indirectly at influencing policy formation or implementation. E-political companies are primarily related to e-election companies and e-advocacy companies.

–E-survey – allows you to obtain citizens' opinions electronically based on a random or targeted sample. As a rule,

citizens are offered questions and options for answers.

–E-cadastre. In Ukraine, the web resource of electronic services of the State Service of Ukraine for Geodesy, Cartography and Cadastre (<https://e.land.gov.ua/>) has been operating for a long time, which provides local self-government bodies with access to the functionality of the State Land Cadastre so that they can provide administrative services to citizens and receive operational information about the region's land resources.

10. E-television. The State Program for Implementing Digital Television and Radio Broadcasting has been implemented in Ukraine for over 15 years. Today, there are more than twenty national digital channels.

11. E-government. This is a system of collecting, inputting, sorting, processing, saving, and outputting at the request of the user by the defined criteria of information resources, which is designed to ensure the provision of services to natural and legal entities by authorities as well as to inform them about the activities of authorities. There are four areas of E-government implementation (Fig. 11.3).

The main advantages of E-government include:

–The only open platform for all processes in the state is the absence of bureaucracy and corruption in communications between ministries, departments, services, institutions, and departments.

–An open circulation system of state funds is a transparent state budget. It allows citizens to work freely and develop businesses through the online database of enterprises, tenders, purchases, exchanges, and banking.

–Open and constantly accessible state ministries, departments, services, institutions, departments, implemented thanks to access via the Internet from home, work, or from automatic boxes on the street – this saves taxpayers money and time on receiving and processing "documents".

–• The only electronic protected ID "document" of a citizen is Passport + Identification code + Foreign passport + Visas + Diplomas, Patents, Certificates, Certificates, Awards + Driver's license + Medical card + Employment book (Specialty, Rank, Seniority, Companies, Projects) + Access to a bank account (several

levels of protection) + Certificate of the owner, participant, pensioner, author, official, etc.

–The only open and permanently accessible judicial system allows citizens to resolve conflicting issues, petitions, and complaints between themselves, their leadership, and the state based on available facts and documents to defend their rights without bureaucracy and corruption.

–The only open electoral voting system is transparent elections.

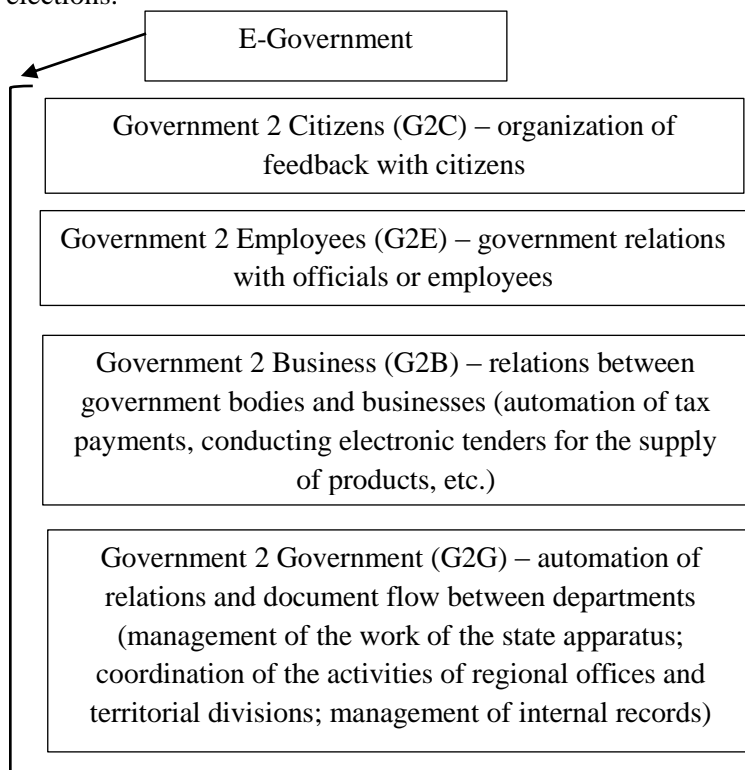


Fig. 11.3. Variants of e-government implementation
Source: developed by the authors

–Up-to-date, open, certified, permanently available education for the needs of the production and service sectors is a source of

development, employment, and security for the state and population.

– Modern project management methodologies at the state level are implementation and the ability to track results and make changes and proposals.

– We are saving money on paper document circulation. For example, every year, the Verkhovna Rada of Ukraine uses about 34 tons of paper, which costs about 600,000 UAH.

11.2 The current state of support for the development of the infrastructure of territorial communities

First of all, it should be noted that all territorial communities in the conditions of war can be divided into:

1. Territorial communities where active hostilities were/are being conducted.

2. Territorial communities where there were no active hostilities.

However, territorial communities will still have their characteristics within each group. They will depend on several factors. For the first group, the most essential characteristics are:

– changes in the number of the population within the territorial community – they are related to the departure of the population or, conversely, the entry in the case of occupation or simply the return of the population – this factor is generally a vital issue for the development of the territory because the recipients of public services are the population and from the further post-war recovery program will depend on its quantity;

– a decrease in the number of entities providing public services, which may be associated with the departure of employees or the destruction of the place of service provision;

– the emergence of a need for new types of services – for example, assistance during hostilities, support for the returning population or internally displaced persons (IDP), assistance with their accommodation (for this, it is possible to transfer communally owned objects to the housing stock or build new structures for temporary accommodation of the creation), help with finding a job,

meeting primary material needs (for example, in clothes or hygiene products);

- the level of damage to public and technical infrastructure – the actual possibility of providing public and technical services will depend on this factor;

- the current state of security (mined areas, presence of military personnel, etc., proximity to the zone of current hostilities or the border with the Russian Federation). And this factor has a significant impact on the development of the territory. After all, even if the current situation does not involve the conduct of active hostilities, but the community is located close to such a zone or the border with the Russian Federation, there are significant limitations in receiving investments for the restoration of the territorial community. For example, the initiatives of the Ministry of Community Development, Territories and Infrastructure of Ukraine (which publishes a list of relevant zones), which were announced in 2023 together with the European Investment Bank, do not provide for financing the restoration of territories classified as "red" and "orange" zones.

The factors that shape the features of the second group of territorial communities are:

- changes in the number of the population, because with a high probability it increased due to the IDP – in this case, there is a problem of a lack of public service entities and opportunities to provide them, both physical (overloading of the health care system, education, etc.) and financial (lack of budget). To solve this problem, we can mention the experience of creating additional local self-government bodies directed exclusively at providing public services to IDPs.

- distance from the war zone and the border with the Russian Federation.

To date, there are several programs aimed at the support and development of territorial communities of Ukraine:

1. The USAID program "Decentralization Offering Better Results and Efficiency" (DOBRE) is a nine-year program implemented by Global Communities and financed by the United States Agency for International Development (USAID), whose main

goals include

- support for the development of strategic development plans;
- within the framework of developing plans to improve the provision of public services – operational and tactical plans to achieve strategic ones;
- training of subjects providing public services – familiarizing them with the best management practices in crisis conditions and cooperation with other territorial communities;
- determine economic growth priorities based on available resources, such as existing and relocated enterprises.
- effective budgeting and financial management
- active participation of citizens in decision-making at the local level, emphasizing the needs and requests of the youth of the territories, as well as IDPs.

2. The PROSTO project «Supporting the availability of services in Ukraine» is a Swedish-Ukrainian project for Ukraine to support the decentralization reform. Its purpose is to strengthen the potential of local authorities to provide services for the benefit of the residents of Ukraine (<https://prosto.in.ua/ua>) and expert assistance in creating and developing the quality of work of administrative service centers.

3. USAID project «Increasing the efficiency and accountability of local self-government bodies» («HOVERLA»): Goal 1: Ensuring increasingly greater institutionalization and efficiency of the system of local self-government in Ukraine. Goal 2: Promote more self-sufficient regional governance. Goal 3: Creation of mechanisms that will help citizens play an increasingly important role in local self-government (<https://decentralization.gov.ua/donors/hoverla>).

4. "U-LEAD with Europe" is a program of cooperation between the Ukrainian government, the European Union, and its member states Germany, Sweden, Poland, Denmark, Estonia, and Slovenia in creating a multi-level governance system that is transparent, accountable, and responsive to the needs of Ukrainian citizens. The main goal of U-LEAD is to strengthen the capacity of critical actors and stakeholders at the national, regional, and local levels to expand local self-governance opportunities in territorial

communities, particularly in times of war and reconstruction. Since the beginning of activity in 2016, about 35,000 direct consultations have been provided to territorial communities (<https://u-lead.org.ua>).

5. The Swedish-Ukrainian Project "Supporting Decentralization in Ukraine," implemented by the SALAR International company as part of the Swedish Association of Local Authorities and Regions (SALAR). Donor: The Government of the Kingdom of Sweden through the Swedish International Development Agency (SIDA). Among many areas: supporting reform monitoring through capacity building and analytics; promoting the establishment of a decentralized education management system; increasing the capacity of communities to manage education, educational budgets, and school networks, including taking into account gender aspects; establishing long-term partnerships between territorial communities of Ukraine and municipalities abroad (<https://salarinternational.org.ua>).

11.3 Recommendations for the formation of service infrastructure of territorial communities

It should be noted that the priority tasks on the way to the formation of the service infrastructure of territorial communities (especially in the conditions of post-war reconstruction include diagnosis of the current state of the territory, planning of goals, tasks, and projects, and risk forecasting (Lapunte, 2020).

As for diagnostics, it is carried out in the following areas:

1. General information about the territorial community: geographical location (proximity to the zone of active hostilities and the border with the Russian Federation), population (total number, gender and age structure, social status and state of health, place of permanent residence, condition unemployment.

2. Based on the received general information, a forecast is made regarding the demographic changes of the population: births/deaths, arrivals/departures, and, accordingly, the forecast value of the new state of the population, information about the administrative center, and features of the territorial community.

3. General information about public services within this territorial community: security, availability, list, analysis of consumers in general and definition of those who use public services, conditions of provision, quality in comparison with other analogs in Ukraine and the EU, material and technical base of service provision, description of suppliers, cost of service, tariffs (do they cover the cost, by whom they are established or revised), other financial issues (additional infusions to the budget: subventions, subsidies, etc.), partnership of subjects, etc.

4. Issues of citizen involvement (surveys, activities of public organizations, analysis of appeals, public activity (meetings, etc.)).

5. State of public and technical infrastructure: existing level, level of damage, condition, and number of unused facilities.

6. Problems in the provision of public services – gaps/gaps based on the identified data and forecast values.

The planning of the recovery program is carried out based on the following limitations: limitations of personnel, financial and time opportunities, the level of qualification of the subjects of service provision, difficulties in ensuring the support of experts (their experience of working in crisis phenomena may not be sufficient for a situation of military aggression).

Here, recovery plans can be focused on the following:

- it is necessary to increase the number of services provided in connection with the increase in the number of people in the territorial community

- it is necessary to increase the use of infrastructure facilities

- the number of infrastructure objects that need to be restored

- based on optimization criteria

- What amount can be spent on additional based on previous data?

The main elements of the plans:

- The main goal is to be quantitatively measured or qualitative (if something has not existed before). However, the degree of its achievement could still be checked through quantitative indicators (time frames, human, financial, etc.).

- tasks for its achievement: intermediate goals, implementation entities, additionally involved entities providing

services, entities receiving services for each project, quantitative and qualitative indicators of achievement, deadlines, sources of funding

– the implementation mechanism of each project: organization of implementation, monitoring, evaluation, and adjustment possibilities

-service providers are involved in the project implementation process.

Risks in the field of post-war reconstruction of territories. One of the main risks is that the local self-government bodies, in their post-war recovery programs of territorial communities, will aim to return to the pre-war state. That is, some changes and improvements may still need to be foreseen. However, this is quite a false statement. After all, the state of the infrastructure and the level of provision of public services in pre-war conditions still needed to meet the needs and demands of the population fully.

It should be noted that the post-war recovery should involve optimizing public services. And the main optimization criteria should be economic feasibility, social justice (compliance with needs), rational spatial planning (compliance with needs), technical capacity, and environmental friendliness.

The subsequent risk is the workload of local self-government bodies. After all, in the case of post-war reconstruction, they should expand the list of public services. In addition, more than their knowledge and qualifications may be required to plan and implement recovery programs. In addition, the lack of motivation and psychological barriers among subjects of public service provision should not be ruled out.

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12. MECHANISMS OF LEGAL REGULATION OF THE DEVELOPMENT OF SMALL AND MEDIUM BUSINESSES AT THE LEVEL OF LOCAL GOVERNMENT BODIES

12.1 Small and medium-sized businesses as an object of state regulation

At the current stage of the development of the Ukrainian economy, support for small and medium-sized businesses at the level of state authorities is among the priority problems. Tax revenues from the entrepreneurial activity of the population of Ukraine are significant economic support for the population of Ukraine and the economy's financial stability. Local governments play an essential role in resolving this issue.

The need to study the economic policy of conducting small and medium-sized businesses as an independent branch of theoretical knowledge became relevant with the beginning of the creation of independent Ukraine, namely with the legalization of entrepreneurial activity at the state level and the adoption of the Laws of Ukraine "On Enterprise," "On Support of Small Entrepreneurship," the Commercial Code, etc.

During the years of implementing changes and complex transformations due to the deepening political crisis and the active search for new critical practical solutions, the modern transition process of our country to the European Union has increased interest in small and medium-sized businesses in Ukraine because it is a profitable investment project. The current stage of European integration is based on the idea that the business environment is a priority area covered by the innovation process and is one of the critical factors in solving financial and political problems on which the promising path of European development will depend, especially in the future period of post-war reconstruction. Now, in the difficult conditions of today, when Ukraine is confronting Russian aggression, the financial and economic component is becoming the

most important for the country's national security; it is the aggression of an external enemy in Ukraine that becomes an occasion for rethinking worldview priorities in the minds of the Ukrainian population (Amosha, Shamileva, 2018).

Therefore, first, special attention is paid to the rapid adaptation of Ukrainian society to new management forms with the help of the European Union. Secondly, researchers have begun to use the understanding of these processes from the height of their scientific knowledge. While adverse events continued in the country, small and medium-sized businesses and entrepreneurship during the war continued developing and changing under the influence of new challenges and needs of society and the state. The above facts, as well as the absence of works devoted to the issue of improving the development strategy of small and medium-sized businesses, especially during the war, as a structural unit of economic policy, by the presented facts.

The following methods were used in the research process: induction and deduction (conclusions about facts regarding the development of small and medium-sized businesses); conclusions were drawn based on knowledge of the general properties of the activity; abstract and logical methods (generalization of the results of the analysis and formation of the findings for each section and general); analysis and synthesis (systematization of trends in the management of small and medium-sized businesses by state authorities) and other statistical methods. The methodological principles of the study are based on the integrative use of general scientific and specially applied methods, such as comparison, abstraction, concretization, and analogy. In addition, schematic and graphic representation and methods of classification and systematization were used, thanks to which it was possible to generalize the regulatory framework and scientific literature within the framework of our study.

The primary focus of our study was on the goals and objectives, scientific opinions, judgments, conclusions and statements, and evaluation criteria of world and domestic science scientists in business management and entrepreneurial activity. Since the issue of regulating the business environment is of interest to

various sciences, the range of methods and principles of research in our work is extensive. The methodological basis for studying this issue is the interdisciplinary connection of existing scientific approaches in various fields of knowledge, as it is located in the chain of public administration, civic education, law, ethnography, sociology, and economics.

As information sources, we work with the legal framework of Ukraine, the EU, and the Council of Europe, the main provisions of modern theoretical knowledge in public economic management, research papers, and articles, reports at international and all-Ukrainian scientific and practical conferences, Internet resources, as well as the results of our research.

However, the problem mentioned above, especially in the context of a military invasion of Ukrainian lands by an external aggressor, is characterized by a rapid course of research. Therefore, the issue requires further research and development (Aref'iev, Yifan, 2017).

Our current stage focuses on the goals and objectives, scientific opinions, judgments, conclusions and statements, and evaluation criteria of world and domestic science scientists in business management and entrepreneurial activity. Since the issue of regulating the business environment belongs to the interests of various sciences, the spectrum of methods and principles of research in our work is vast. The methodological basis for studying this issue is the interdisciplinary connection of existing scientific approaches in various circles of knowledge. It is in public administration, civic education, law, ethnology, sociology, and economics.

Scientific novelty according to the results of the study, for the first time, theoretical provisions on the development of small and medium-sized businesses during martial law have been formulated and substantively substantiated, and methodological recommendations have been provided on civil protection of the business environment in modern conditions of martial law in Ukraine, which can be implemented in practice and significantly affect the achievement of new socio-economic results. Contribute to the further development of science in economics and public

administration. The genesis of the development of entrepreneurial activity has been clarified, revealing the patterns and main paths of development of small and medium-sized businesses (Armstrong, Conyon, 2019)

Entrepreneurship is a critical link in the economy. Still, its success is often limited by unprofessional management by local governments and a need for more adaptation to a rapidly changing environment. In this context, an innovative approach to managing the business environment is of particular importance, as it allows the business environment of Ukraine to be competitive and effectively adapt to changes, especially in modern conditions. The problem lies in the need to find new forms of entrepreneurship management in all areas of economic activity by small and medium-sized businesses (from now on referred to as SMEs) to ensure sustainable community development. In this context, there is a need to study methods and strategies of innovative management mechanisms aimed at increasing the competitiveness of SMEs. The purpose of the study is to systematize and analyze the existing mechanisms of legal regulation of the development of SMEs, identify advantages and disadvantages, as well as develop recommendations for the practical implementation of protecting SMEs from threats of external environmental impact, such as ecological catastrophes, crisis phenomena associated with full-scale enemy aggression and an imperfect legal framework at the level of local governments (Belyaeva, Petrenko, 2024).

Small and medium-sized businesses are one of the decisive conditions for the development of the economy, which affects the development of society and determines the financial path of the nation. Thanks to entrepreneurship development, income stability, ideals of quality life are established, project ideas, innovations, and technologies are implemented, and the preservation and increase of the population's income and assets are ensured.

Ukraine is boldly walking along the path of a market economy using the experience of leading countries. There is certainly a big gap between world leaders and Ukraine, but there are standards to which we must strive.

According to the value of gross domestic product (GDP),

when the value of the output of goods and services produced in a country during one year has increased, the World Bank allocates three lists of countries in the world by rating. The dollar estimates of GDP were obtained using the purchasing power parity (PPP) calculation. Some of the data below are the results of calculations by the International Monetary Fund; the rest are from the US Central Intelligence Agency, as a result of which some inconsistency is possible (Byba, Tenytska, 2011).

The World Bank has published a ranking of the world's economies by their size for 2023. Ukraine rose two positions and, resulting in over \$178.7 billion, took 57th place among all countries worldwide, losing to Hungary and Qatar. The leaders are the USA and China by a wide margin.

According to general statistical data, international ratings of Ukraine depict indicators among other countries of the world, as well as unique social, economic, and political indices and ratings.

SMEs play a significant role in developing SMEs, which local governments and the territorial community significantly influence. First, it is worth noting that the concepts of "small business" and "medium business" differ only in the quantitative indicator of the personnel involved in the work; in small business, up to 49 people, and on average, from 50 to 249 individuals.

The business environment in Ukraine involves entrepreneurial activity or running a small and medium-sized business; it is a structural system organization of labor, which generally covers all economic activity at one's discretion and risk to make a profit; it is a system of forming human relations in the field of economics using the introduction of new forms and methods of management, taking into account innovative and investment activities (Bolkvadze, (2020). It can be said that the development of small and medium-sized businesses today occurs not only due to the economic potential of the country, since the resource system is exhausted by the war, but also due to the introduction of innovations by local governments and foreign investments, pan-European projects that find their place in the business environment of Ukraine.

SME, as a subordinate unit of state administration and at the regional level subordinate to local governments, means a set of

various material, financial, intellectual, and economic means for making a profit and new jobs, forming a competitive economy.

In the course of our research, it was found that the most sound concepts of small- and medium-sized business development are cyclical development, which uses systemic experience and investing capital.

SMEs are a fundamental component of the state economy. Individual entrepreneurs (from now on referred to as individual entrepreneurs) perform essential activities, as a result of which significant financial support is provided to the budget of Ukraine, namely - providing jobs for the population, supporting and improving the quality of life of the population, meeting the needs of Ukrainians. Small and medium-sized businesses are mobile, quickly respond to market needs and changes, are usually profitable, and offer unique goods and services. The main thing is to use all the knowledge and rules for conducting entrepreneurial activity (Bolkvadzem, 2020). This is primarily a study of the regulatory framework of legislation regulating the activities of small and medium-sized businesses, choosing a field of activity, and creating a business plan, the correct approach to the use of human and financial resources, the region of implementation of activities and the ability to find places for entrepreneurial activity. Small and medium-sized businesses can be considered an alternative to wage labor, and the regulation of SME development is essential for forming the middle class of the population. The Ukrainian government considers small and medium-sized businesses and individual entrepreneurship as one of the ways to replenish the state treasury; therefore, frequent changes and additions to existing legislation sometimes occur very rapidly. However, it should be noted that small and medium-sized businesses and the number of enterprises and individual entrepreneurs perform several essential economic and social functions, the most important of which are the following:

- providing the population with the fact of employment: increasing the number of business entities and individuals and, accordingly, the emergence and creation of new jobs (registration of individual entrepreneurs, etc.);

- providing mobility and adaptation to the market. Small and

medium-sized business entities take into account market needs more carefully, communicate with consumers faster, and serve the population better;

- the competitive environment is rapidly forming and changing according to the requirements in the conditions of life crisis phenomena in the economy during the war, which stimulates a new search for methods of production of goods, services, and works that become in demand in the market;

- a de facto structural restructuring of the market is carried out, entrepreneurs gain freedom of market choice;

- usually set the direction of economic growth, generating and implementing innovative ideas (commercial, technical, marketing, social, and others); unlike system production, they produce goods that are in demand and provide essential services.

12.2 Organizational and legal support in the field of small and medium-sized businesses in Ukraine

The criteria for motivational activity in starting one's own business or opening the status of an entrepreneur are influenced by various factors. Ukrainians usually do not actively take the initiative to start their own business. The fear and risk of changing their social status and starting a new form of business are influenced by the territorial component, the subjective character traits of a person, the ability to qualitatively think through the steps of business planning, calculate the amount of a loan or credit if there is no money to start a business.

So, the principles of running an SME at the stage of market relations and during a full-scale invasion of the enemy into the territory of Ukraine are associated with many risks, difficulties, and negative factors. We note that economic relations between business entities in the regions of Ukraine and neighboring states - Poland, Romania, Moldova, Hungary, and Slovakia - are also gaining relevance. We consider it appropriate to consider the unhindered movement of Ukrainian goods and business products through customs control.

The process of SME development in Ukraine gained momentum after the update of the regulatory framework and the adoption of new legislation on entrepreneurial activity, which legalized free trade and opened the way for the emergence of new business entities.

Increasing the practical activity of small and medium-sized business entrepreneurs depends on many circumstances. We are talking about the development of foreign trade as an adequate opportunity to improve the country's economic potential. Not all entrepreneurs can overcome customs control in a timely and unhindered manner, which poses a significant risk to trade. Studying foreign experience and acquiring new competencies in customs personnel management is advisable.

Customs administrations, due to the nature of their missions and the fact that they operate in an environment marked by complex interaction, have to participate in modernization constantly. In other words, they must regularly update and improve their operating models and work and personnel management methods. While strategies, systems, processes, and tools are critical to this activity, the driving force behind customs operations remains the human capital of customs personnel (Ivchenko, 2016).

During the COVID-19 pandemic, humanity has increasingly realized that a healthy, resilient workforce is the greatest asset of the customs administration. Customs officers perform operational and support functions and are vital to the business continuity and organizational resilience associated with managing customs services.

Therefore, HRMD professionals in customs must play a vital role in their organization, especially in influencing the adaptive capabilities of their structural unit. In practice, more than ever, HRMD professionals are called upon to provide innovative responses to the new challenges related to trade development, security, and health, transforming their contribution and ensuring that their recommendations are aligned with corporate strategic priorities (Malec, 2022).

The World Customs Organization promotes the vision of the Customs Service as a coherent professional organization with unique work models, consisting of individuals who share specialized and

generalized knowledge, skills, and attitudes and are committed and competent in responding to modern economic and social challenges. By the Resolution of the Verkhovna Rada of Ukraine dated June 19, 1992, No. 2479-XXII and the Resolution of the Cabinet of Ministers of Ukraine dated June 1, 1992, No. 229, Ukraine acceded to the 1950 Convention establishing the Customs Cooperation Council and has been a full member of the World Customs Organization since November 10, 1992. Accordingly, in 2016, the Council of Ministers approved an approach to personnel management based on the best competencies from international practice.

To enable Customs administrations to assess their level of maturity in this area, the World Customs Organization (WCO) has developed a “People Development Diagnostic Tool” (PDDT), which is also aligned with the norms and guidelines set out in the Framework of Principles and Practices for Customs Professionalism, as well as with professional standards.

These principles include professional competencies:

- introduction of reference documents for HR strategy, aimed at identifying the fundamental components of HR strategy and, by default, elementary failures;
- compilation of a diagnostic questionnaire focusing on the presence and effectiveness of core HR practices and processes, as well as the legal and ethical foundations of HR strategy;
- Creating a values matrix that identifies the perceptions of crucial HR players regarding the shortcomings in implementing best practices in their HR management experience in their administration.

Having conducted over 90 diagnostic missions on human resource development across continents since 2014, the Secretariat of the World Customs Organization has identified common challenges and success factors. The missions noted that human resource professionals in customs are limited to an administrative role, focusing on processing human resource transactions. They often struggle to manage their workload effectively, and their positioning in all aspects of HRM practice tends to be reactive. Instead, they need to be proactive and go beyond the traditional administrative management role to support the strategic choices of their administrations.

Despite developing a comprehensive set of tools and guidance for implementing a competency-based approach to HRM in the Customs environment, numerous assessments conducted by the Secretariat worldwide have identified a competency gap in HR teams, resulting in limited effectiveness. This gap prevents Customs administrations from fully realizing the benefits of competency-based HRM. Rather than adopting an integrated approach that addresses the full spectrum of HR issues, many Customs administrations have resorted to “quick fixes” to HR problems, often by hiring international management consulting firms that do not have specific experience or knowledge of the Customs profession and environment. These solutions focus on a single HR “problem,” such as performance management, organizational restructuring, or training, and use generic approaches that are not specific to or adapted to the Customs environment. Since these efforts are driven by external parties with little interest in the organization's health or individual employees' problems, such “quick fixes” often fall short of expectations. Meanwhile, the competence of HR staff in approaching HR issues remains low. The role of HR is usually perceived negatively as not creating value for the organization and not facilitating career growth. The only solution to change the perception of Customs leadership is to equip HR with agents of change.

The WCO Secretariat's engagement with Customs administrations on HR issues has shown that the most effective administrations are well aware of the value of their staff and invest in their development (Voynarenko Dzhedzhula, Yepifanova, 2023).

The WCO's capacity development strategy incorporates a people-centered approach, in which the human factor is at the center of all actions. Capacity-building programs are conducted on the principle that personnel development and investment in customs authorities' professionalism are fundamental principles of successful reform and modernization of customs authorities, including implementing measures provided by the Agreement on Trade Facilitation of the World Trade Organization. Without investment in people and the professionalism of customs authorities, reforms and modernization cannot be successful.

As the central executive body, the State Customs Service of Ukraine is vital in ensuring and implementing state policy in state customs affairs. Providing high-quality communication and information customs services will allow representatives of small and medium-sized businesses to cooperate freely with foreign colleagues and receive timely and comprehensive information with the least expenditure of time and resources. Customs authorities should consider advanced foreign experience in facilitating and reorganizing the roles and responsibilities of customs personnel, which will allow for a rapid response to the strategic needs of the state and the population, thereby guaranteeing the effective conduct of foreign economic relations.

Legalization should be understood as a sequence of legally significant actions by a person exercising his right to engage in entrepreneurship to legalize this activity. The legalization of entrepreneurship depended at that time on the person's actions. Given the economic crisis after the collapse of the Soviet Union, the majority of the population remained unemployed, enterprises became unprofitable, and the standard of living began to fall rapidly. The emergence of new legislation on business entities partially resolved the issue of unemployment. It opened the way for free trade in the domestic market and foreign exchange.

With the adoption of legislation to support business, the process of internal legalization and implementation of the type of activity of choice has opened, as well as information collection, organizational processes - saving capital, selection of professional staff of employees, preparation of supporting documentation, creation of business plans, etc. Internal legalization includes agreements that define the organizational and legal form of the business entity.

Certification for doing business at the legislative level - is a legitimate concept. It aims to ensure consumer rights and maintain the authority of the national producer in the markets of goods, services, and works. The official document after passing the certification is the Certificate.

Thus, passing the certification procedure is a particular activity determined by a state institution and aimed at confirming the

compliance of a specific type of product, service, or process with the requirements of the level of need in society, safe use, and quality without harm to human health.

In October 2020, the Law of Ukraine, “On State Support of Small Entrepreneurship,” was adopted (Vidomosti VRU, 2013, No. 3, p. 23) – the State Fund for SME Support was established. The priority tasks of the fund are economic and financial support of state policy in the field of support of small entrepreneurship and medium-sized businesses and the creation of an effectively operating investment mechanism for the implementation of the state economic program, participation in the financing of regional programs, as well as projects and measures aimed at the support and development of small and medium-sized businesses.

To fulfill these tasks, municipal authorities implement the following main areas of management activity of business entities:

1) develop an economic strategy for the region and territorial community with the involvement of state and foreign investments to ensure the development of SMEs in the country;

2) contribute to the formation of a tax regime for various categories of individuals working in the SME sector;

3) form the leasing system as one of the promising ones in the direction of creating and developing the business environment;

4) contribute to the development of the activity of business entities, attracting foreign investments;

5) using grant and project support programs, they are engaged in training personnel to work in small and medium-sized business structures;

6) try to create conditions for the successful development of entrepreneurial activity by forming a favorable infrastructure, lending, and satisfying consumer needs;

7) actively conduct information and regulatory and legal support for entrepreneurs' activities in small and medium-sized businesses using social networks, meetings, and business clubs to communicate and exchange experience.

State support programs for SMEs provide conditions for development by increasing the efficiency and quality of state support measures at the territorial level. To achieve this goal, legal regulation

of the business environment is carried out by updating the regulatory framework. Let us consider the current laws of Ukraine in the field of SMEs.

According to Art. 1 of the Law of Ukraine “On State Support of Small Entrepreneurship,” business entities may be individuals who are registered by the legislative procedure as business entities; legal entities – business entities of any organizational and legal form and form of ownership, in which the average number of employees does not exceed 50 people, and the volume of annual gross profit does not exceed 70 million hryvnias.

The law defines the legislative framework for state support for business entities to quickly overcome the economic crisis and create conditions for anti-crisis reforms in Ukraine. The state aims to support representatives of small businesses formally, create conditions for growth in the economy of Ukraine, promote the formation and development of business in Ukraine, the emergence of the small business economic system as a leading force in the economy, the creation of a competitive economic environment and ensuring a sustainable society; support for Ukrainian manufacturers; providing jobs, employment of the population of Ukraine, preventing unemployment.

The executive body of government supports SMEs in Ukraine – the Cabinet of Ministers of Ukraine, the central executive body for regulatory policy and entrepreneurship, and other central executive bodies.

In Art. 7 of the Law of Ukraine "On State Support for Small Business" as amended on 05.10.2024, business environment support programs were defined and contain the following provisions: financial, credit, investment support, ensuring the participation of business entities in the implementation of supplies for state orders, regional and local needs; improving the legislative framework in the field of entrepreneurial activity; promoting the creation of infrastructure for the development of small businesses; proposals for establishing a system of benefits for small businesses, including easing tax policy; assistance in material and technical and information support, and also contains specific national, regional and local programs to support small businesses. Article 10 of the law

mentioned above provides for creating and delivering networks of business centers and business incubators and defines their main functional tasks.

The law also provides certain benefits, such as the possibility of applying a simplified system of taxation, accounting, and reporting compared to the current general system of taxation, accounting, and reporting.

The new basis for cooperation between the state and the business environment on the partnership path, taking into account the interests of the parties, has become the Law of Ukraine's "On Public-Private Partnership." Considering Ukraine's political and economic processes, investments are being poured in thanks to a fair and transparent trade policy, essential for strengthening Ukraine's position in the EU. Compliance with all standards in Ukraine's climate protection, environment, and labor protection should come first. European leaders and Western financiers are actively establishing cooperation with Ukraine to implement a comprehensive strategy for countries around the world.

The European Commission is trying to support international cooperation with Ukraine, considering the development of our country's economy and business, research and innovation, using several instruments, agreements, programs, projects and initiatives, and strategic partnership measures worldwide. The world-famous Horizon Europe program, which is an essential functional tool of EU cooperation, expands opportunities for scientists, entrepreneurs, and innovators in the global space, taking into account existing limitations that have been recognized as substantial during complex tests in Ukraine.

International cooperation is carried out in many directions. In direction 1. "Advanced Science" - scientists receive Marie Skłodowska-Curie fellowships for research groups or grants. In another direction, it is suitable for business environment representatives and involves all stakeholders' involvement in joint proposals from consortia.

On October 25, 2024, with the support of the program from EU4 Business, an online meeting called "Presentation of the results of the grant program for 100 Ukrainian SMEs with export potential

and innovative ideas” was held – 184 participants, including representatives of the Ministry of Economy of Ukraine, the Delegation of the European Union to Ukraine. During the meeting, experts from the NGO EasyBusiness proposed practical grant support tools for the development of Ukrainian enterprises and proposed criteria for successful grant support. Participants in the grant program shared their experiences and results of participation in programs and competitive projects. Thanks to the grant funds received, some entrepreneurs increased their income and sales; some improved their production process, which resulted in gaining new clients in Europe; and some developed updated websites and strategies for promoting their products. Thus, every fact proves that Ukrainian business and entrepreneurship have great potential for recovery and development.

For Ukrainian industrialists, grants are a significant help in implementing marketing tasks. Thanks to business support programs, enterprises in Ukraine are developing to survive difficult times. Thanks to grants from the EU and Germany, production is being replenished and improved. The main task of business in Ukraine is to develop export potential; thus, with the help of grant support, the productivity of production and services is increasing. Grant programs are a source of confidence for Ukraine during difficult times.

The organization "HELVETAS Swiss Intercooperation" – in support of business and the economy, HELVETAS is a Swiss organization for implementing sustainable development initiatives worldwide. The main work areas aim to support livelihood programs, economic recovery, and building resilience worldwide, helping entrepreneurs create and retain jobs, expand exports, and increase profits. In this way of working together, public-private partnership is defined as a system of relations between states and organizations, partners and allies in the implementation of specific opportunities for both partners, the desire to unite, with appropriate risk sharing, responsibility for obtaining a result for mutually beneficial cooperation for a long time in creating renewed operating economies that require attracting innovations and investments.

Thus, legislative regulation of the business environment is an essential tool for stimulating entrepreneurship, affecting the

conditions for its creation, functioning, and development, and gradually adapting to international standards, which ensures improvement and competitiveness in the global market. Removing barriers and creating a favorable legal environment will stimulate entrepreneurship, develop activity, and sustain economic growth. In this context, consideration of individual forms of influence on the development of SMEs that have developed throughout the process of social transformation is of particular importance.

However, for the full development of entrepreneurship, it is necessary to continue improving the regulatory framework, simplify regulatory procedures, and actively implement effective state innovation support programs. Other types of SME development were also implemented partly because the modernization of entrepreneurship as a mechanism that carries out civilization can be complete or fragmentary, complete or incomplete, rapid or slow. In addition, when considering the modernization of SMEs as a set of tasks, their selection, and implementation, it is essential to take into account the existence of certain boundaries, which, however, are very mobile and are absolute and conditional in terms of use, explicit and hidden in the form of manifestation, superficial and deep in terms of the sequence of use. It is logical that depending on these features, different results of the processes of activity renewal are achieved. However, the following remains undeniable. The concept of SME modernization constitutes the methodological basis of almost all transformation processes that concern various aspects of society's socio-economic life.

12.3 The contribution of small and medium-sized businesses to Ukraine's victory

So, as we can see, the business environment is formed quickly thanks to innovation and investment activities, despite the introduction of martial law. The situation becomes dangerous due to hostilities and long-term threats during the alarm; local governments must primarily care for the population and its safety. To prevent the development of communities and territories from being slowed

down, municipal authorities must connect all departments and management structures, respond to society's challenges in a coordinated and rapid manner, and make decisions through the emergence of new tasks. Under challenging conditions in Ukraine, rapid response processes are taking place on the part of state authorities and local governments regarding the regulation of SMEs and entrepreneurial activity. The ability to quickly respond to challenges and threats in society, to make a high-quality management decision, to take actual action in managing the activities of the business environment to regulate the state of all participants in economic relations by the rules of law is one of the priority tasks of the state and local governments at the level of the territorial community. Only a strong team in local governments can comprehensively cover the chain of problems, adopt relevant regulatory legal acts, influence the creation of favorable conditions for business development in the interests of society and the state as a whole, and meet the needs of the population of a particular community. The main task in such a situation is the legal regulation of state support for SMEs at the level of local authorities to keep the population from emigrating, provide jobs, and support the region's economic development. In the first section, we characterized SMEs in Ukraine, organizational and legal regulation, and modern and historical retrospect.

We note the peculiarities of border areas, the significant impact of hostilities on business, and the critical state of infrastructure due to constant destruction. Services and local government bodies have the task of solving problems immediately. Therefore, we believe that what is needed is to create favorable conditions for the stable activities of entrepreneurs, overcome barriers to business development, take into account the latest innovative and investment technologies for business support, concentrate funds and instruments on priority areas of small and medium-sized businesses, according to needs, industries; concentrate and optimize resources, their use in the operation of infrastructure facilities and support for entrepreneurship, which will strengthen the social status of the territorial community, increase the prestige of the work of entrepreneurs, expand the areas of activity for small and

medium-sized businesses and entrepreneurial activity.

Thus, today, for the transition to innovative development of the Ukrainian economy, the problem of not just researching and mastering actual mechanisms for acquiring new knowledge but its transformation into technological innovations as the basis for the structural transformation of the economy comes to the fore. In the conditions of the development of an information-based economy, when the creative abilities of people, capable of constantly generating new technologies, become a qualitatively new resource in the production process, an essential factor in the formation of the desired parameters of innovative development, from the point of view of the long-term growth of socio-economic, cultural, creative standards of society, it is necessary to consider not so much purely economic, but the entire content of government policy aimed at developing people's creative abilities, the principles of political organization of society, etc. This leads us to the question of the prospects of a new approach to implementing the laws of economic progress. Thanks to innovations, the multiplier effect increases due to cost savings and the attraction of internal reserves.

The effectiveness of the socio-economic system, modern socio-economic relations are established and developed, and economic well-being is growing. This is the supporting structure of radical transformations that must be implemented to ensure economic growth. That is, not just modernization, but innovative development as its strategy must become an objective reality, changing the style and meaning of life of society as a whole and an individual. What is especially important is that along with science and technology, all aspects of social life must become a source of creative and purposeful innovative activity. Among the main tasks of such a theory, it is essential to highlight the need for modernization efforts to develop a universal, but not abstract, but specific mechanism for financing an innovative economic development model. In the most generalized form, it is necessary to focus on solving two groups of tasks. Firstly, to ensure financial maneuver in the direction of rational use of available financial resources for development: from a macroeconomic point of view of all components of the innovation development system and a

microeconomic point of view - not pseudo-innovations, but those innovations that can contribute to obtaining one or another effect or long-term growth trends. Secondly, increasing financial potential for maximum use of innovative development opportunities.

This places high demands on the state and its ability to conduct qualitative economic reforms. When the place of the state is created mainly by external factors (comparison with the West, developed countries), that is, a goal is set that is somewhat ahead of the level of maturity of its economic and socio-political institutions, independent determinants of society's progress are insufficiently developed. There is a need for a more stringent definition of goals and increased management control. New principles for implementing the innovation process should not allow such a development of events.

The functional content of state management of innovation processes in the economy must be significantly updated. To understand the specifics of the state's role, it is fundamentally vital to distinguish modern industrialization. Its qualitative differences also determine the state's role in developing SMEs. In decentralization, the central issue of state economic policy is the concentration of resources on priority areas of technical progress and the mobilization of all resources for this purpose. Considering the essential specifics of a post-industrial society, the state's role in regulating the development of SMEs should be strengthened, meet the population's needs, and protect businesses from external and internal threats, destructive factors, and environmental disasters. Therefore, we consider it appropriate to pay attention to civil protection and the security of the business environment.

Ukrainian business during the war is unique and multifaceted. The CSR Development Center, an organization of experts on sustainable development, created the first Catalog of the contribution of small and medium-sized businesses to Ukraine's victory. With the help of the partner Action – Business, a national project for developing entrepreneurship and exports, it was found that today, in Ukraine, over 300 campaigns are operating, including 227 national, 83 international, and four more cases representing business partnerships. Participating companies represent SMEs – 124

companies, Big Business – 189, and 1 Business Association. The top 6 business environment sectors in the CSR Case Catalog are IT companies – 87; agriculture – 37 companies; hospitality and retail – 23 companies each; industry and production – 17 companies; logistics – 15 companies; other sectors of the economy – 112 companies.

Everyone works for victory on their front, so we know that business in Ukraine continues to work to provide food and goods, essential services to the population and the territories of front-line zones, border areas where hostilities are taking place and to provide humanitarian aid to support the army and internally displaced persons.

The main areas of contribution of Ukrainian business during the war are economic aid, humanitarian support, timely and high-quality tax payment, participation in information resistance, assistance to employees, and IT support.

Monetary aid: the total economic aid sent by 72 companies to support the army amounted to over 2 billion UAH. to special accounts of the NBU and specialized funds. The most popular fund in Ukraine is the “Return Alive” Foundation. In addition to the money transfer, another 107 companies provided the necessary cars and equipment, creating their funds to raise funds. There are also known cases when enterprises send part of their daily/monthly profits to accounts for army aid. In total, at least 177 companies – more than half – contributed to assisting the Armed Forces of Ukraine.

Small and medium-sized businesses transferred over 3 billion UAH for humanitarian aid. The assistance in the form of products amounted to more than 200 million UAH, but the above amount is several dozen times greater. One hundred thirty-six companies transferred products to the Armed Forces of Ukraine (now referred to as the AFU), the Defense Ministry, hospitals, and territorial communities. Also, 17 companies helped with logistics and the collection of aid, and 15 organized the evacuation process for the population. More than 60 thousand liters of fuel were transferred from gas stations and enterprises for the needs of the army and, hospitals, emergency vehicles; 19 companies, pharmaceutical

businesses, pharmacies, clinics transferred medicines worth more than 70 million UAH to the Armed Forces of Ukraine, hospitals and the population in the territory of hostilities. Analyzing the sources of assistance from entrepreneurship, we determined the fundamentality of innovative development for socio-economic progress in Ukraine. We revealed the multifactorial nature of this continuous systemic process, characterized by numerous conditions, particularly financial ones, that reflect it, objectively limit it, and contribute to its effective implementation. In a broad sense, all this is the choice of methodology for the development of SMEs, which is of decisive importance not only for the direction of scientific research but also for the vocation to develop ways to implement innovative development of the business environment.

However, more than understanding innovation processes in entrepreneurial activity and theoretical hypotheses is needed for an adequate solution to such tasks. That is, the multilevel concept of understanding the innovative development of SMEs and the factors of its financial support as its integral component includes an empirical analysis of the dominant trends of these processes. At the same time, an adequate assessment of their current state involves the following steps. First, it is critically important, in our opinion, to begin such an analysis by finding a starting point relative to which it is possible to assess the nature of the quantitative and qualitative changes that have already occurred, in other words, the state of innovative development, then identify the most significant factors that influence their dynamics to realize the scale of the changes that are yet to occur.

Secondly, given the global trends of globalization that affect the development of SMEs, an international survey of innovation trends is of particular importance to answer the question of Ukraine's place in the global innovation process.

Thirdly. Given the importance of a systemic approach and the significance of the financial component in Ukraine, the task arises to improve the situation surrounding the financing of the SME innovation development system. After all, modern policy on introducing an innovative path of development into economic processes, as noted above, can bring a positive result only if there is

a systemic approach to implementing all components of the innovation development system.

And, finally, fourthly. Given the tasks' complexity, the need to develop appropriate analytical tools is becoming more urgent. It should be noted that some tools of such analysis in economic science have already passed the stage of fundamental research. Still, others have yet to be studied much, especially in assessing the quality of innovation development. Therefore, their search is one of the essential aspects of regulating the growth of SMEs. With such a methodology, the results obtained in the course of the work can ultimately ensure the unity and integrity of the theoretical concept and the empirical result of the study to give them theoretical and, most importantly, significant applied significance.

An essential and defining result of our study is the clarification of systemic changes in all components that regulate innovation processes in the development of SMEs and their crucial prerequisite - a high level of vocational and educational training for the population. This is one of the indicators by which a country's belonging to the developed ones is determined.

For example, annual studies on the population's quality of life have shown that the satisfaction of needs, standard of living, and life expectancy directly depend on the community's economic status, increasing the role of the knowledge-based economy. Firstly, the material well-being of the state and the population is ensured by scientific research, innovations, and high technologies, as well as by the appropriate educational level. Secondly, it is essential to consider that SME employees remain a potential reserve for replenishing the middle class, and the numerical predominance in the structure of society is necessary for the sufficiently rapid and stable development of the state and regions. High professional training facilitates adaptation to the market environment, reduces the risk of poverty, increases the likelihood of obtaining average incomes, and affects the lifestyle, particularly consumer behavior. Thirdly, one must pay attention to the possibilities of the knowledge system's influence on the nature of the work of public authorities in regulating the activities of SMEs.

As a result, this encourages us to make appropriate

adjustments, rapidly respond to motivational mechanisms to the needs of time, economy, and social life, and timely orientation of the content of the knowledge system, as well as their constant support.

Development processes initiated in the economy despite the war contributed to intensive transformation in this area through changes:

- In-demand mechanisms (quantitative changes in the population that seeks to obtain professional education and a working profession because it is relevant or who wish to retrain);

- in supply mechanisms (taking into account the needs of society and the community individually, depending on the situation);

- in competition mechanisms (due to an increase in the supply of services);

- in forms of ownership (pluralism);

- in forms of management (decentralization);

- in forms of organization (transition to a tiered education system);

- in financing mechanisms (sources of financing become more diversified, the possibility of providing paid services by representatives of SMEs);

- in legislative support (there is a need for changes and the emergence of new laws).

It is easy to see that many of the problems in SMEs' development lie primarily in financial support. In the structure of fixed assets of the Ukrainian economy, non-productive sector funds during 2022-2023 occupied an average of about 35%. According to pre-war facts, there is a discrepancy in Ukraine with UNESCO regulatory requirements, according to which the recommended amount of state spending on SME development should be at least 6% of GDP. As we can see, SME financing in Ukraine must meet more than the minimum international standards and the increased requirements that must be met in transitional economies and economies transitioning to an innovative development path.

The policy of the Government of Ukraine regarding financing entrepreneurship and providing loans and credits for development needs to be more consistent. Financing ranged in an extensive range from 10.2 to 21.6% of all state spending. This indicates large

fluctuations in the absolute amounts of budget expenditures and, as a result, the need for more functional and structural continuity in the government's budget policy regarding public spending.

Comparative analysis provides much information for reflection. Despite the compliance of the relative indicators of GDP redistribution with the average trend in Europe, the absolute volumes of financing the business environment significantly lag behind the average European ones in Ukraine. In part, such a gap can be explained by the differentiation of living standards, price differences, and other factors.

We must assess this issue with a detailed analysis of the state of affairs in this area. With a high level of reliability, we can only say that the “underfinancing” of SMEs in Ukraine is associated with its total commercialization, the effect of conjunctural factors in the services market.

Statistics show that the growth of investment volumes and financing of entrepreneurs occurs due to the redistribution of funds within one of their limits. As we can see, the dynamics of the structure of distribution of state expenditures on SMEs lead to a deterioration in qualitative indicators, which is a negative factor for economic development. Due to this trend and the negative aspects associated with the war, the quality of services provided by SMEs in Ukraine has significantly decreased compared to previous years. There is a tendency to increase the level of differentiation of the population in terms of quality of life and financial capacity.

Therefore, the world community is trying to support small and medium-sized businesses in Ukraine with joint efforts, bringing victory closer and preventing the people of Ukraine from losing faith in a bright future. In addition to the external enemy, a significant threat to small and medium-sized businesses is the danger caused by crisis phenomena during martial law, such as fires, destruction of critical infrastructure, floods, drought, etc. Therefore, the civil protection of the population and the business environment of the regions of Ukraine, especially those that, due to their geographical location, border the aggressor country and are subject to constant shelling and threats, is becoming increasingly relevant for local governments.

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Appendix A

Artistic groups of territorial communities of Sumy region that have the title of "folk" or "exemplary" amateur group (studio)

Title group (studio)	Year of foundation	Year of awarding the title	Genre direction
Bezdryk community			
Folk amateur dance ensemble "Barvy" of Tokari Village House of Culture	1976	1996	folk (including stylized) and modern choreographic compositions
The exemplary amateur dance ensemble "Mriya" of the Bezdryk Village House of Culture	1992	1995	folk (including stylized) and modern choreographic compositions
Berezivka community			
The amateur folklore group "Verbychenka" of the Oblozhky Village House of Culture of the municipal institution of the Berezivka Village Council "Berezivka Center for Culture and Leisure"	1982	2006	Ukrainian folk, ceremonial and everyday local songs, songs by contemporary Ukrainian authors
Folk amateur vocal women's ensemble "Berizonka" of the municipal institution of the Berezivka Village Council "Berezivka Center for Culture and Leisure"	1975	2006	folk singing
Bilopilliya community			
Folk amateur choir of the municipal institution of the Bilopilliya City Council "Bilopilliya Center for Culture and Leisure "Ukraine"	1950	1965	folk singing
Veteran amateur vocal ensemble of the municipal institution of the Bilopil City Council " Bilopilliya Center for Culture and Leisure	1987	2014	folk singing

"Ukraine"			
Folk amateur vocal ensemble "Lileia" of the municipal institution of the Bilopil City Council " Bilopilliya Center for Culture and Leisure "Ukraine"	2008	2014	folk and pop singing
Folk amateur vocal ensemble of Ukrainian songs of branch of the municipal institution of the Bilopilliya City Council " Bilopilliya Center for Culture and Leisure "Ukraine" of the Hannivka-Vyryvska Village House of Culture	1983	1995	folk singing
Folk amateur vocal women's ensemble "Ryzhivski Divytsi" of branch of the municipal institution of the Bilopilliya City Council " Bilopilliya Center for Culture and Leisure "Ukraine" of the Ryzhivka Village House of Culture`	2013	2018	folk and pop singing
Folk amateur vocal ensemble of Ukrainian songs of branch of the municipal institution of the Bilopilliya City Council " Bilopilliya Center for Culture and Leisure "Ukraine" of the Kuyanivka Village House of Culture	2005	2010	folk and pop singing
Bochechky community			
Folk amateur vocal women's ensemble "Prolisky" of Bochechky Village House of Culture	1998	2003	folk singing
Amateur vocal ensemble of folk songs "Kozachanochka" of Kozatske Village House of Culture	1997	2010	folk singing
Amateur folklore group "Krynichenka" of Dukhanivka Village House of Culture	1985	2002	family rituals, calendar rituals and everyday songs
Buryń' community			

Folk amateur choir "Chervona Kalyna" of the municipal institution of Buryn City Council "Buryn House of Culture"	1953	1980	folk singing
Folk amateur male vocal ensemble of the communal institution of Buryn City Council "Buryn House of Culture"	1976	1980	folk singing
Folk amateur vocal women's ensemble "Nadiya" of the communal institution of Buryn City Council "Buryn House of Culture"	1975	1999	folk singing
The exemplary amateur dance ensemble "Perlyna" of the municipal institution of Buryn City Council "Buryn House of Culture"	1991	1999	folk (including stylized) and modern choreographic compositions
The amateur folk orchestra of folk instruments of the municipal institution of Buryn City Council "Buryn House of Culture"	1967	2002	folk (including stylized) and modern musical compositions
Folk amateur instrumental ensemble "Troisti Muzyky" of the municipal institution of Buryn City Council "Buryn House of Culture"	1980	1985	folk (including stylized) and modern musical compositions
People's amateur film and video studio of the municipal institution of Buryn City Council "Buryn House of Culture"	1975	1977	audiovisual art
The exemplary amateur theater of the municipal institution of Buryn City Council "Buryn House of Culture"	1988	1991	children's performances, pop miniatures
The exemplary amateur vocal ensemble "School Years" of the municipal institution of Buryn City Council "Buryn House of Culture"	2001	2010	pop and folk singing

The amateur folklore group "Spivanochka" of the municipal institution of Buryń City Council "Buryń House of Culture"	2010	2018	old local, ritual, family, calendar and contemporary songs by local authors
Amateur vocal ensemble of folk songs "Piskivchanka" of Pisky Village House of Culture	2012	2018	folk singing
Amateur vocal ensemble of folk songs "Uspenskiy Yarmarok" of Uspenka Village House of Culture	1983	1990	folk singing
Velyka Pysarivka community			
Folk amateur vocal ensemble "Zoretzvit" of the Municipal Institution "Center for Cultural Services" of Velyka Pysarivka House of Culture" of Velyka Pysarivka Village Council	1975	1998	folk and pop singing
Folk amateur folklore ensemble "Vechornytsi" of Tarasivka branch of the Municipal Institution "Center for Cultural Services" of Velyka Pysarivka House of Culture" of Velyka Pysarivka Village Council	1968	2003	folk singing
Folk amateur vocal women's ensemble "Vilnyanochka" of Vilne branch of the Municipal Institution "Center for Cultural Services" of Velyka Pysarivka House of Culture" of Velyka Pysarivka Village Council	2006	2023	folk singing
Folk amateur vocal female ensemble "Veseli Molodychky" of Rozsosh branch of the Municipal Institution Center for Cultural Services "Velykopysarivskiyi House of Culture" of Velyka Pysarivka village Council	1974	2023	folk singing

Verkhnia Syrovatka community			
Folk amateur brass band of Verkhnia Syrovatka Village House of Culture	1912	1998	brass music
Folk amateur theater of Verkhnia Syrovatka Village House of Culture	1969	1993	plays by Ukrainian and foreign authors, fairy tales, miniatures
The amateur folk dance ensemble "Iskrynka" of Verkhnia Syrovatka Village House of Culture	1985	1991	folk choreography
Vilshana community			
Amateur vocal ensemble of folk songs of Vilshana Village House of Culture	2007	2014	folk singing
The Zhuravka amateur folklore group of Vilshana Village House of Culture	2006	2014	local ceremonial and everyday songs
Folk amateur vocal women's ensemble "Vizerunok" of Komyshi Village House of Culture	2009	2014	folk singing
Hlukhiv community			
Folk amateur choir of sacred music of the municipal institution "Hlukhiv City Palace of Culture" of Hlukhiv City Council	1990	2000	academic singing
Folk amateur vocal man's ensemble of the municipal institution "Hlukhiv City Palace of Culture" of Hlukhiv City Council	2002	2006	folk and pop singing
Folk amateur vocal women's ensemble of the Municipal Institution "Hlukhiv City Palace of Culture" of Hlukhiv City Council	2002	2006	folk and pop singing
The exemplary amateur vocal studio "Good Evening" of the Municipal Institution "Hlukhiv City Palace of Culture" of Hlukhiv City Council	1996	2006	pop singing

Folk amateur dance ensemble "Polisyanochka" of the Municipal Institution "Hlukhiv City Palace of Culture" of Hlukhiv City Council	2000	2003	folk (including stylized) story choreographic compositions
Folk Amateur Youth Theater "Pilgrim" of the Municipal Institution "Culture Center" of Hlukhiv City Council	1990	1996	classics, plays by contemporary Ukrainian and foreign authors, performances for children
The amateur vocal ensemble "Molodist" of the Municipal Institution "Culture Center" of Hlukhiv City Council	1975	1984	pop singing
Folk amateur dance ensemble "Kroky" of the Municipal Institution "Culture Center" of Hlukhiv City Council	2010	2018	folk dances, modern choreographic performances, story dances
The amateur folklore group "Chervona Kalyna" of Nekrasivka Village House of Culture, a branch of the Municipal Institution "Culture Center" of Hlukhiv City Council	1970	1990	Ukrainian folk, ritual and everyday songs, traditional calendar holidays and rituals
Folk amateur vocal women's ensemble "Liubava" of Poloshky village House of Culture, a branch of the municipal institution "Culture Center" of Hlukhiv City Council	1989	2010	folk singing
Folk amateur vocal women's ensemble "Zhuravka" of Dunavitsi Village House of Culture, a branch of the Municipal Institution "Culture Center" of Hlukhiv City Council	1983	1999	folk singing
Hrun'			
Amateur vocal ensemble of folk songs "Khutoryany" of Rybalske Village House of	1992	2006	Folk singing (accompanied by noise)

Culture			instruments)
People's amateur theater of humorous miniatures "Smikhograi" of Hrun' Village House of Culture	1998	2002	humorous miniatures
Amateur folklore group "Slobozhany" of Hrun' Village House of Culture	1996	1999	local songs of various genres, ritualistic performances, folk choreography and instrumental performance, oral folklore
Exemplary amateur folklore group "Makivka" of Hrun' Village House of Culture	1998	1999	ceremonial events, children's games and entertainment
Druzhba			
Folk amateur vocal ensemble "Druzhbyanochka" of the municipal institution "Druzhbivka City Palace of Culture"	2003	2018	Ukrainian folk songs, songs by contemporary Ukrainian authors
Dubovyazivka			
The exemplary amateur vocal ensemble "Shchebetukhy" of the municipal institution "Dubovyazivskyi Center for Culture and Leisure"	2015	2018	folk and pop singing
Folk amateur vocal ensemble "Malvy" of Vyazove Village House of Culture	2007	2018	folk and pop singing
Folk amateur vocal women's ensemble "Zavodyanochka" of the municipal institution "Dubovyazivskyi Center for Culture and Leisure"	2015	2018	folk and pop singing
Folk amateur choir of Simianivka Village House of Culture, a branch of Dubovyazivka Center for Culture and Leisure	1968	1985	folk singing
Folk amateur instrumental ensemble "Veseli Muzyky" of Simianivka Village House of Culture, a branch of	2010	2014	folk and pop singing

Duboviazivka Center for Culture and Leisure			
The exemplary amateur folklore group "Vesnyanochka" of Simianivka Village House of Culture, a branch of Duboviazivka Center for Culture and Leisure	1995	2010	ceremonial, lyrical and children's songs
Folk amateur instrumental ensemble "Yezuch" of Hruzske Village House of Culture, a branch of Duboviazivka Center for Culture and Leisure	1971	1994	folk and pop singing
Folk amateur theater "Strings of the Soul" of Zemlianka Village Club, a branch of Duboviazivka Culture and Leisure Center	2015	2018	musicals, skits, variety miniatures
Esman' community			
Folk amateur vocal women's ensemble "Berehynya" of the municipal institution "Esman Rural House of Culture" of Esman Village Council	1983	2006	folk singing
Znob-Novgorod community			
Folk amateur vocal women's ensemble "Verbychenka" of the Municipal Institution "Znob-Novhorod Cultural Services Center" of Znob-Novhorod Rural Council	1976	2010	folk singing
Folk amateur folklore ethnographic collective "Desnianka" of Ochkyne Village House of Culture, a branch of the Znob-Novhorod Cultural Services Center of the Znob-Novhorod Rural Council	1980	1992	ceremonial and everyday songs
Kyrykivka community			
The exemplary amateur brass band of Ryabyna Village House of Culture, a branch of the municipal institution	1965	1973	Brass music

"Center for Culture and Leisure" of Kyrykivka Rural Council			
Amateur folklore group "Ryabinushka" of Ryabyna Village House of Culture, a branch of the municipal institution "Rural for Culture and Leisure" of the Kyrykivka Village Council	1960	1987	traditional ritual performances, theatricalized folk calendar holidays
Komyshi community			
Folk amateur vocal ensemble of Ukrainian song "Susidka" of Mala Pavlivka Village House of Culture	1986	1992	Folk singing (accompanied by noise instruments)
The exemplary amateur dance ensemble "Suzirya" of Mala Pavlivka Village House of Culture	1998	2006	folk (including stylized) and modern choreographic compositions
Folk amateur vocal ensemble "Zhyva Voda" of Komyshi Village House of Culture	1972	1992	folk singing
Amateur folklore group "Komyshanske Nadvechirya" of the Komyshanske Village House of Culture	1983	2014	local calendar and ceremonial, family and household authentic songs
Konotop community			
Folk amateur choir "Ridna Pisnia" of the Municipal Institution "Konotop City House of Culture "Zoryanyi""	2000	2002	folk singing
Folk amateur choral group of war and labor veterans of Konotop City House of Culture "Zoryanyi"	1997	2007	academic and folk singing
People's Amateur Theater of the Municipal Institution "Konotop City House of Culture "Zoryanyi""	1947	1997	performances based on plays by Ukrainian and foreign authors, children's performances
Folk amateur vocal ensemble "Rhapsody" of the Municipal Institution "Konotop City	2007	2010	pop singing

House of Culture "Zoryanyi"			
The exemplary amateur studio of decorative and applied arts "White Crow" of the Municipal Institution "Konotop City House of Culture "Zoryanyi"	2007	2010	decorative painting, decoupage, quilling, newspaper weaving, graphics and other mixed media
The exemplary amateur dance ensemble "Free danse" of the Municipal Institution "Konotop City House of Culture "Zoryanyi"	2012	2014	pop, folk stylized choreographic compositions
The exemplary amateur ballroom dance ensemble "Triumph" of Konotop City House of Culture "Suchasnyk"	2014	2018	ballroom and sports choreography
Korovyntsi community			
Folk amateur man's vocal ensemble "Koloryt" of the Municipal Institution "Korovyntsi Culture and Leisure Center"	1975	2000	folk singing
Amateur vocal ensemble of folk songs "Ternytsia" of the Municipal Institution "Korovyntsi Culture and Leisure Center"	1993	2006	folk singing
People's amateur theater of the Municipal Institution "Korovyntsi Culture and Leisure Center"	1960	1995	Ukrainian classics, interludes
Folk amateur vocal man's ensemble "Nashchadky Tomasa" of the Tomaszivka Village House of Culture, a branch of the Korovyntsi Center for Culture and Leisure	1986	2003	folk singing
Krasnopillia community			
Folk amateur vocal ensemble "Dzherelo" of Municipal Institution "Krasnopillia Palace of Culture"	2010	2014	Ukrainian folk songs (arranged) and modern pop songs
Folk amateur brass band of Municipal Institution "Krasnopillia Palace of	1989	1993	Brass music

Culture"			
Folk amateur brass band of Samotoivka Village House of Culture	1983	2018	Brass music
The exemplary amateur dance ensemble "Zoryanochka" of Municipal Institution "Krasnopillia Palace of Culture"	1993	2005	folk (including stylized) and modern choreographic compositions
The exemplary amateur dance ensemble "Berezil" of Chernechchyna Village Club	2006	2014	folk (including stylized) and modern choreographic compositions
The amateur folklore group "Shcheholok" of the Verkhnia Pozhnyia Village House Of Culture	1985	1988	ceremonial and everyday songs
Krolevets community			
Folk amateur instrumental ensemble "Lady Impulse" of the Krolevets City Council Culture Center	2000	2005	Instrumental music
Folk amateur vocal ensemble "Malvy" of Krolevets City Council Culture Center	1995	2000	pop singing
Folk amateur vocal ensemble "Pisenne Dzherelo" of Krolevets City Council Culture Center	1992	1995	folk and classical singing
Amateur dance ensemble "Flamingo" of the Culture Center of Krolevets City Council	1995	2003	modern choreographic compositions
Folk amateur instrumental ensemble of the Culture Center of Krolevets City Council	1955	1973	instrumental music
Folk amateur vocal ensemble "Berehynia" of Krolevets City Council Culture Center	2000	2014	folk singing
Folk amateur dance ensemble "Smile" of Culture Center of Krolevets City Council	2014	2018	modern pop choreography
Amateur folk dance ensemble	1999	2010	modern

"Zodiac" of Altynivka House of Culture, a branch of the Krolevets City Council Culture Center			choreographic compositions
Folk amateur choir of the Altynivka House of Culture, a branch of the Krolevets City Council Culture Center	1985	1994	folk singing
Folk amateur vocal ensemble "Zori" of Bozhkivka House of Culture, a branch of Krolevets City Council Culture Center	1988	2000	folk singing
Folk amateur vocal women's ensemble "Verbychenka" of Hrechkyne House of Culture, a branch of Krolevets City Council Culture Center	1977	2007	folk singing
Folk amateur vocal ensemble "Kalyna" of Obtove House of Culture, a branch of the Krolevets City Council Culture Center	1994	2014	folk singing
Lebedyn community			
Folk amateur vocal ensemble "Lebedyna Pisnia" of the municipal institution "Lebedyn City Center for Culture and Leisure" of the Executive Committee of Lebedyn City Council	1983	1998	folk singing
Folk amateur ensemble of acoustic music of the municipal institution "Lebedyn City Center for Culture and Leisure" of the Executive Committee of Lebedyn City Council	1997	2002	folk and pop singing
Folk amateur vocal ensemble of authentic singing "Strila" of the municipal institution "Lebedyn City Center for Culture and Leisure" of the Executive Committee of Lebedyn City Council	1998	2002	folk and authentic singing
Folk amateur choir of war and	2001	2006	folk singing

labor veterans of Lebedyn City Center for Culture and Leisure of the Executive Committee of Lebedyn City Council			
The amateur vocal studio "Ovation" of Lebedyn City Center for Culture and Leisure of the Executive Committee of the Lebedyn City Council	2000	2010	pop singing
The exemplary amateur vocal ensemble "Fairy" of the municipal institution "Lebedyn City Center for Culture and Leisure" of the Executive Committee of Lebedyn City Council	2013	2018	pop singing
Folk amateur vocal ensemble "Oksamytovi Zori" of Lebedyn City House of Culture of the Executive Committee of Lebedyn City Council	2008	2018	folk and pop singing
Folk amateur vocal ensemble "Lebedia" of Lebedyn City House of Culture of the Executive Committee of Lebedyn City Council	1999	2000	folk singing
Folk Amateur Theater "Orpheyi" of Lebedyn City House of Culture of the Executive Committee of Lebedyn City Council	1913	1968	Ukrainian classics, pop miniatures, performances for children
Amateur folk dance ensemble "Kaleidoscope" of the municipal institution "Lebedyn City House of Culture" of the Executive Committee of Lebedyn City Council	2007	2010	folk and modern choreographic compositions
Folk amateur ballroom dance ensemble "Gracia" of the municipal institution "Lebedyn City House of Culture" of the Executive	1998	2006	ballroom and sports choreography

Committee of Lebedyn City Council			
Folk amateur vocal ensemble "Kalyna" of Vasylivka Village House of Culture, a branch of Lebedyn City Center for Culture and Leisure of the Executive Committee of Lebedyn City Council	2007	2014	folk and pop singing
Folk amateur vocal ensemble "Chervona Kalyna" of Ryabushky Village House of Culture, a branch of Lebedyn City Center for Culture and Leisure of the Executive Committee of Lebedyn City Council	1982	2002	folk singing
Lypova Dolyna community			
Amateur vocal ensemble of folk songs "Khorol" of the municipal organization "Center for Culture and Leisure" of Lypova Dolyna Rural Council	1993	2013	folk singing
Folk amateur vocal ensemble "Svitanok" of the municipal organization "Center for Culture and Leisure" of Lypova Dolyna Rural Council	1993	1996	folk and pop singing
Folk amateur theater "Fantasia" of the municipal organization "Center for Culture and Leisure" of Lypova Dolyna Rural Council	1986	1998	Ukrainian classics, pop miniatures
Folk amateur instrumental ensemble of the municipal organization "Center for Culture and Leisure" of Lypova Dolyna Rural Village Council	2006	2010	folk and pop singing
Folk amateur vocal ensemble Kalynonka of the Moscovskiy Bobryk House of Culture, a structural unit of the municipal organization "Center for	1980	1993	folk singing

Culture and Leisure" of Lypova Dolyna Rural Village Council			
Mykolaivka Rural community			
Folk amateur instrumental ensemble "Mriya" of the municipal institution "Mykolaivka Center for Culture and Leisure"	1989	1998	folk and pop singing
Amateur folk choir "Lyubystok" of the municipal institution "Mykolaivka Center for Culture and Leisure"	1969	1973	folk singing
Folk amateur dance ensemble "Serpanok" of the municipal institution "Mykolaivka Center for Culture and Leisure"	1963	1967	folk (including stylized) choreographic compositions
Amateur instrumental folk music ensemble "Veseli Muzyky" of the of the municipal institution "Mykolaivka Center for Culture and Leisure"	1986	2002	folk singing
Folk Amateur Theater "Pereveslo" of the municipal institution "Mykolaivka Center for Culture and Leisure"	1989	1992	Ukrainian classics
Exemplary amateur modern pop dance ensemble "Fantasia" of the municipal institution "Mykolaivka Center for Culture and Leisure"	2003	2010	modern pop songs
Folk amateur brass band of the branch of the municipal institution "Mykolaivka Center for Culture and Leisure", Ulianivka Village House of Culture	1985	1995	brass music
Folk amateur vocal women's ensemble "Gorlytsia" of the municipal institution	2013	2018	folk and pop singing

"Mykolaivka Center for Culture and Leisure", Markivka Village House of Culture			
Folk amateur choir of the municipal institution "Mykolaivka Center for Culture and Leisure", Ulianivka Village House of Culture	1985	1990	folk singing
Mykolaivka village community			
Folk amateur choir of Mykolaivka Village House of Culture	1922	1991	folk singing
Folk amateur choir of Krovne Village House of Culture	1956	1992	academic singing
Myropillia community			
Folk amateur choir of the Sinnivka House of Culture	1967	2011	folk singing
Folk amateur vocal ensemble "Kalyna" of Mala Rybytsia Village House of Culture	1970	2018	folk singing
Nedryhailiv community			
Amateur folk brass band "Mammoth Band" of the municipal institution "Nedryhailiv Center for Culture and Leisure of Nedryhailiv Village Council"	1945	2002	brass music
Folk amateur choir of the municipal institution "Nedryhailiv Center for Culture and Leisure of Nedryhailiv Village Council"	1946	1967	folk singing
Folk amateur vocal women's ensemble "Horlytsia" of the municipal institution "Nedryhailiv Center for Culture and Leisure of Nedryhailiv Village Council"	2004	2010	folk singing
Folk amateur male vocal ensemble "Rozmay" of the municipal institution "Nedryhailiv Center for Culture and Leisure of the	2001	2010	folk singing

Nedryhailiv Village Council"			
Folk amateur vocal women's ensemble "Oksamyt" of Ivanivka Village House of Culture, a branch of the municipal institution "Nedryhailiv Center for Culture and Leisure of Nedryhailiv Village Council"	2010	2014	folk singing
Folk amateur vocal women's ensemble "Kumasi" of Kurmany Village House of Culture, a branch of the municipal institution "Nedryhailiv Center for Culture and Leisure of Nedryhailiv Village Council"	2003	2010	folk singing
Nyzhnia Syrovatka community			
Folk amateur choir of Nyzhnia Syrovatka Village House of Culture	1932	1985	folk singing
Folk amateur choir of Stare Selo Village House of Culture	1935	1971	folk singing
Amateur folk song ensemble "Starosilski Berehyny" Nyzhnia Syrovatka	2010	2022	folk art
Nova Sloboda community			
People's amateur folklore group "Kolos" of the municipal institution " Nova Sloboda Village House of Culture"	2001	2003	local ritual and household songs
The amateur folklore group "Siva Zozulenka" of Yurivka Village House of Culture branch of the municipal institution " Nova Sloboda Village House of Culture"	1969	1998	local rituals, folk songs
Amateur folklore group "Horyunochka" of the Lynove Village Club of the municipal institution " Nova Sloboda Village House of Culture"	2006	2014	local ritual and household songs
Okhtyrka community			
Folk amateur vocal ensemble	1999	2004	folk singing

"Barvy" of the municipal institution "Okhtyrka City Center for Culture and Leisure "Knezha"			
Folk amateur vocal ensemble of Ukrainian song "Kalyna" of the municipal institution "Okhtyrka City Center for Culture and Leisure "Knezha"	2002	2006	folk singing
Folk amateur choir of veterans of war, labor and military service of the municipal institution "Okhtyrka City Center for Culture and Leisure "Knezha"	1986	2010	folk singing
The exemplary amateur vocal ensemble "Koloryt" of the municipal institution "Okhtyrka City Center for Culture and Leisure "Knezha"	2014	2018	pop singing
The exemplary amateur vocal ensemble "Kroshky" of the municipal institution "Okhtyrka City Center for Culture and Leisure "Knezha"	1999	2002	pop singing
The exemplary amateur classical dance ensemble of the municipal institution "Okhtyrka City Center for Culture and Leisure "Knezha"	1974	2008	ballroom and classical choreography
Popivka community			
Folk amateur vocal man's ensemble "Yezuch" of Popivka Village House of Culture, a branch of the municipal institution "Center for Culture, Leisure and Sports" of Popivka Village Council	2001	2002	folk singing
The exemplary amateur vocal studio "Samotsvity Konotopshchyny" of Popivka Village House of Culture, a branch of the municipal institution "Center for Culture,	2000	2002	folk and pop singing

Leisure and Sports" of Popivka Village Council			
Folk amateur vocal ensemble "Dyvohrai" of Popivka Village House of Culture, a branch of the municipal institution "Center for Culture, Leisure and Sports" of Popivka Village Council	2005	2014	folk singing
Folk amateur vocal ensemble "Real Black Cats" of Popivka Village House of Culture, a branch of the municipal institution "Center for Culture, Leisure and Sports" of Popivka Village Council	2014	2018	pop singing
Folk amateur instrumental ensemble "Different Dreams" of Popivka Village House of Culture, a branch of the municipal institution "Center for Culture, Leisure and Sports" of Popivka Village Council	2015	2018	pop singing
Folk amateur vocal women's ensemble "Kalynonka" of Kuzky Village House of Culture, a branch of the Center for Culture, Leisure and Sports of Popivka Village Council	1981	2002	folk singing
Folk amateur theater of Shevchenko village club, a branch of the Center for Culture, Leisure and Sports of Popivka Village Council	2000	2002	Ukrainian classics, pop miniatures
Amateur folklore group "Verbychenka" of the Malosambir village house of culture, a branch of the municipal institution "Center for Culture, Leisure and Sports" of the Popivka Village Council	1972	2014	ceremonial and everyday songs

Putyvl community			
Folk amateur vocal ensemble of folk songs "Starushky veselushky and Diedushky-parubochky" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	1990	2006	folk singing
Folk amateur vocal ensemble "Barvy" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	1987	1989	pop singing
amateur vocal ensemble "Nadezhda" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	2001	2003	pop singing
The amateur choir "Veteran" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	1975	1988	folk singing
Folk amateur vocal ensemble "Siveriyany" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	2007	2008	Ukrainian folk songs, Cossack songs, contemporary Ukrainian pop
Amateur vocal ensemble of folk song "Ne horiuy" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	2006	2010	Ukrainian folk songs
The exemplary amateur choir of the municipal institution "Putyvl House of Culture" of Putyvl City Council	1992	1998	folk and pop singing
Folk amateur dance ensemble "Orhidea" of the municipal institution "Putyvl House of Culture" of Putyvl City Council	1995	2003	folk (including stylized) and modern choreographic compositions
People's Amateur Theater of the municipal institution "Putyvl House of Culture" of the Putyvl City Council	1960	1973	plays by Ukrainian and foreign authors, children's performances,

			interludes, miniatures
amateur folklore group "Yaroslavna" of the municipal institution "Putivl House of Culture" of Putivl City Council		1998	local calendar and ritual songs, family and household songs, recreation of Highlander traditions
Folk amateur vocal ensemble "Zhuravonka" of the Skunosove Village Club, a branch of the municipal institution "Putivl House of Culture" of Putivl City Council	2011	2014	folk singing
The amateur folklore group "Beryushok" of the Rudneve Village House of Culture, a branch of the municipal institution "Putivl House of Culture" of Putivl City Council	2002	2006	ritual performances, local folk songs
Richky community			
Folk amateur choir of Richky Village House of Culture	1983	1985	folk singing
Folk amateur vocal male ensemble "Atamany" of Richky Village House of Culture	2012	2018	folk singing
Romny community			
Folk amateur choir "Melodies of Life" of Romny City House of Culture	1987	1993	folk singing
Amateur folk vocal ensemble of modern and folk songs "Zoretsvit" of Romny City House of Culture	2003	2006	folk singing
Folk amateur vocal ensemble "Osokory" of Romny City House of Culture	2011	2014	folk singing
Amateur pop vocal studio "Unison" of Romny City House of Culture	2013	2018	pop singing
The exemplary amateur dance ensemble "Perlyna" of Romny	1999	2002	folk (including stylized) and

City House of Culture			modern choreographic compositions
The exemplary amateur dance ensemble "Energia" of Romny City House of Culture	2002	2009	plot, folk, ballroom, modern, stylized dances
The exemplary amateur dance ensemble "Dyvoherai" of Romny City House of Culture	2004	2010	Ukrainian folk, stylized, modern choreographic compositions
The exemplary amateur art studio "Magic Palette" of Romny City House of Culture	2013	2018	painting (watercolor, acrylic, gouache, pastel, oil, etc.)
Folk amateur choir of Bobryk Village House of Culture	1985	1988	folk singing
Folk amateur brass band of Bobryk Village House of Culture	2012	2018	brass music
The amateur folklore group "Nadvechirya" of the municipal institution of Romny City Council "Velyki Bubny House of Culture"	1978	2002	local folk songs
The exemplary amateur pop singing studio "Rushnychok" of the municipal institution of the Romny City Council "Velyki Bubny House of Culture"	1993	2002	pop singing
Folk amateur vocal man's ensemble "Posulski Kozaky" of the Pustoviitivka Village House of Culture	1985	2002	folk singing
Folk amateur vocal women's ensemble "Silver Springs" Rohyntsi Village Club		2010	folk singing
Folk amateur vocal ensemble "Slobozhany" of the Romny City House of Culture	1993	1998	folk singing
Sad community			
Folk amateur choir of Sad Village House of Culture of Sad Village Council	1973	1998	folk singing
Folk amateur choir of the	1985	2007	folk singing

Velyki Vilmy Village House of Culture of Sad Village House of Culture of Sad Village Council			
The exemplary amateur brass band of the municipal institution "Holubivka Village House of Culture" of Sad Village House of Culture of Sad Village Council	1993	2003	brass music
Seredyna-Buda community			
Folk amateur vocal women's ensemble "Polissia Zori" of the municipal institution "Seredyna-Buda Center for Culture and Leisure" of Seredyna-Buda City Council	1991	2001	folk and pop singing
Stepanivka			
Folk amateur choir of Stepanivka Village House of Culture of Stepanivka Village Council	1969	1984	folk singing
Folk amateur choir of Stepanivka Village Club of Stepanivka Village Council	1975	1998	folk singing
Folk amateur vocal women's ensemble "Dyvohrai" of Stepanivka Village House of Culture of Stepanivka Village Council	2010	2018	folk singing
Amateur vocal ensemble of folk songs "Horlytsia" of Pidlisnivka Village House of Culture of Stepanivka Village Council	1952	2005	folk singing
Folk amateur choir of Kosivshchyna Village House of Culture of Stepanivka Village Council	1976	1987	folk singing
Folk amateur vocal ensemble "Kosivchanochka" of Kosivshchyna Village House of Culture of Stepanivka Village Council	1980	1988	folk singing

Sumy community			
Amateur vocal ensemble of folk songs "Vizerunky" of Pushkariivka Village House of Culture	1960	1993	folk singing
Folk amateur brass band of Velyka Chernechchyna Village House of Culture	1963	2002	brass music
Folk amateur choir of Stetskivka object of leisure activities	1957	1994	folk singing
The amateur folk song ensemble "Krynytsi" of Velyka Chernechchyna Village House of Culture	1986	2023	folk singing
Trostanets community			
Folk amateur vocal ensemble "Ukrainian Song" of the municipal institution of Trostianets City Council "Center for Cultural Services"	2000	2003	folk singing
Folk amateur instrumental ensemble "Retro" of the municipal institution of Trostianets City Council "Center for Cultural Services"	2002	2003	folk and pop singing
Folk amateur vocal women's ensemble "Sribni Rosy" of the municipal institution of Trostianets City Council "Center for Cultural Services"	2007	2010	folk, pop singing and own compositions
Folk amateur vocal ensemble of Ukrainian song "Perlyna Slobozhanshchyny" of Bilka Village House of Culture, a branch of the municipal institution of Trostianets City Council "Center for Cultural Services"	2003	2010	folk singing
The amateur folklore group "Ryabinushka" of the Dernove Village House of Culture, a branch of the municipal institution of Trostianets City Council "Center for Cultural	1974	2014	ritual songs

Services"			
The exemplary amateur folklore group "Kukushechka" of Semeren'ky Village House of Culture, a branch of the municipal institution of Trostianets City Council "Center for Cultural Services"	1992	2018	Recreating folk customs and rituals
Amateur folk choir "Veteran" of the City Club "Veteran" a branch of the municipal institution of the municipal institution of Trostianets City Council "Center for Cultural Services"	1991	2003	folk singing
Chernetchyna community			
Amateur folk song ensemble "Rodoslav" of the municipal institution "Center for Culture and Leisure" of Chernechchyna Village Council	2005	2006	folk and pop singing
The exemplary amateur vocal pop singing ensemble "Flash" of the municipal institution "Center for Culture and Leisure" of Chernechchyna Village Council	2003	2006	pop singing
The exemplary amateur dance ensemble "Malvy" of the municipal institution "Center for Culture and Leisure" of Chernechchyna village council	1995	1999	folk and pop singing
The exemplary amateur dance ensemble "Zhart" of the municipal institution "Center for Culture and Leisure" of Chernechchyna Village Council	2010	2014	folk (including stylized) and modern choreographic compositions
Folk amateur song and dance ensemble "Horlytsia" of the municipal institution "Center for Culture and Leisure" of Chernechchyna Village	1989	1991	folk singing

Council			
Folk amateur youth theater "Chudaki" of the municipal institution "Center for Culture and Leisure" of Chernechchyna Village Council	1995	1998	Plays by Ukrainian and foreign authors, fairy tales, pop miniatures
Folk amateur vocal ensemble "Veselka" of Vysochanske Village House of Culture	1979	1987	pop and folk singing
The exemplary amateur dance ensemble "Sunny Bunnies" of Khukhra Village House of Culture	2003	2010	modern choreographic compositions
The exemplary amateur dance ensemble "Caramels" of Khukhra Village House of Culture	2003	2018	modern and folk choreographic compositions
Amateur folklore group "Restless hearts" of Khukhra Village House of Culture	2004	2018	local calendar and ritual songs and family songs
Amateur folk song ensemble "Cherneckchanochka" of Chernetchyna Village House of Culture	1985	1995	folk singing
People's amateur theater "Ukrainian vaudeville" of Chernetchyna Village House of Culture	2012	2018	Ukrainian classical, pop thumbnails
Chupakhivka community			
Folk amateur folklore group "Pereveslo" Lantrativka House of Culture	1985	1995	local calendar and ritual songs and family songs
Shostka community			
Folk amateur choir "Zhayvir" of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1980	1988	folk singing
The amateur choir of labor veterans "Kalynonka" of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1984	1999	academic singing

Folk amateur vocal ensemble "Charivnytsi" of Obrazheyivka Village House of Culture, a branch of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1984	1996	folk and pop singing
The exemplary amateur dance ensemble "Darunok" of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	2001	2006	folk (including stylized) and modern choreographic compositions
The exemplary amateur folklore group "Prolisky" of Voronezh Village House of Culture, a branch of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1999	2002	rituals, games, children's amusements, oral folklore
Folk amateur vocal ensemble "Yavorina" of Voronezh Village House of Culture, a branch of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	2011	2018	folk and pop singing
The exemplary amateur studio of decorative and applied arts "Colorful World" of Voronezh Village House of Culture, a branch of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	2011	2018	batik, Petrykivka painting, thread painting, relief levkas, salt dough modeling, glass painting, Easter egg making, fabric applique, quilling and other mixed techniques
The amateur folklore group "Krynychenka" of Myronivka Village House of Culture, a branch of the municipal institution of Shostka City Council "Shostka Center for	1980	1998	local calendar and ritual songs and family songs

Culture and Leisure"			
Amateur folklore group "Folk Rites" of Sobykh Village House of Culture, a branch of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1970	2010	local calendar and ritual songs and family songs
Amateur folklore group "Vyshyvanka" of the Shevchenkivske village club, a branch of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1990	2010	local authentic songs, family and household rituals
Folk amateur ensemble of Ukrainian song "Veselka" of the municipal institution of Shostka City Council "Shostka Center for Culture and Leisure"	1990	1989	folk singing
Yunakivka community			
Folk amateur choir of Yunakivka Village House of Culture of the Yunakivka Village Council	1967	1984	folk singing
Yampil' community			
Folk amateur choir "Barvinok" of the municipal institution "Yampil Center for Culture and Leisure" of Yampil Rural Council	1967	1984	folk singing
The exemplary amateur dance ensemble "Alliance" of the municipal institution "Yampil Center for Culture and Leisure" of Yampil Rural Council	2002	2006	folk (including stylized) and modern choreographic compositions
Folk amateur vocal ensemble "Polissia" of the municipal institution "Yampil Center for Culture and Leisure" of Yampil Rural Council	2000	2005	folk singing
Folk amateur vocal ensemble "Krynytsia" of the municipal	1999	2002	folk singing

institution “Yampil Center for Culture and Leisure” of Yampil Rural Council			
Folk amateur vocal ensemble "Kalynovi Zori" of the municipal institution “Yampil Center for Culture and Leisure” of Yampil Rural Council	2002	2006	pop singing
Amateur folklore group “Paliyivchanka” of Paliyivka branch of the municipal institution “Yampil Center for Culture and Leisure” of Yampil Rural Council	2013	2018	local ceremonial and family songs, local folklore

Appendix B

List of public roads of district value in the Sumy region

Zip code and road number	Names of highways	Length
Konotop district		
C 190202	Pisky – Novyi Myr	4.7
C 190203	Mikhailovka – Temne	2.0
C 190204	Mykhailivka – Nova Oleksandrivka	2.9
C 190205	Shpokalka – Hatka	4.3
C 190206	Sapushyno – Kopylove	2.9
C 190207	Mykolaiivka – Boshevka	7.7
C 190208	Buryky – Romanchukove	6.0
C 190209	Zhukivka – NoDihtiarkaiusivka	4.6
C 190210	Cherepivka – Karpenkove	5.1
C 190211	Snizhky – Vyshnevyi Yar	3.8
C 190212	(P-61) – Snizhky – Pasiiovyni	5.9
C 190213	Sukhoverkhivka – Nyzhnia Saharivka	2.5
C 190214	Kharchenky – Yarove – (T-19-14)	6.0
	Entrances from (P-61)	
C 190215	to Romanchukove	1.9
C 190216	to Bolotivka	3.3
C 190217	to Atamanske	0.5
C 190218	to Holuby	1.6
	Entrances from (T-19-10)	
C 190219	to Chalyshchivka	1.8
	Entrances from (T-19-14)	
C 190220	to Shkumatove	3.4
	Entrances from (O 190207)	
C 190221	to Shevchenkove	2.8
C 190222	to Nechaivka	2.6
	Entrances from (T -19-19)	
C 190223	to Viktorivka	1.2
C 190224	to Kubrakovo	1.0
	Entrances from (O 190201)	
C 190226	to Bondari	3.0
C 190227	Uspenka – Verkhnya Saharivka	7.2
C 190228	Ternivka – Cherceha Sloboda	5.2
C 190501	Kalyshenkove – Zaliznychne	5.1
	Entrance from (C 190501)	
C 190502	to Marianivka	3.5
C 190503	Novomutyn – Prylukhzhia	2.9
C 190504	Konotop – Sarnavshchyna	1.9

C 190505	Savoyske – Bondari	2.2
C 190506	Sosnivka – Vilne	5.5
C 190507	Yurivka – Mykhailo – Hannivka – Fesivka.	14.6
C 190508	Mykhailo – Hannivka – Ulianivka	2.9
C 190509	Vyazovoye – Zhyhaylivka	2.7
C 190510	Vyazove – Sovynka – Chervonyi Yar	8.5
C 190511	Saltykove – Rokytne	3.1
C 190512	Malyi Sambir – Velykyi Sambir	7.8
C 190513	Termivka – Chernecha Sloboda	1.8
C 190514	Khyzhky – Kozatske	9.7
C 190515	Viazove – (T-19-10)	2.3
C 190516	Kurylivka – Krasne	5.7
C 190517	(O 190513) – Anyutino – (O 190206)	3.1
C 190518	Shevchenkove – Koshary	9.5
	Entrances from (P-61)	
C 190519	to Selyshche	5.3
C 190520	to Kokhanivka	1.4
C 190521	to Topolino	2.7
C 190522	to Lebedeve	0.7
C 190523	to Vyshneve	1.9
	Entrances from (P-60)	
C 190524	to Bondari	1.7
C 190525	to Novoselivka	1.1
C 190526	to Kapitanivka	2.1
C 190527	to Nehaivka	2.0
C 190528	to Pekary	3.0
C 190529	Entrances from (T-19-10) to Dubynka	1.2
C 190530	Entrances from (O 190503) to Poltavka	1.5
C 190531	Entrances from (O 190502) to Tulushka	2.4
C 190532	Entrances from (O 190509) to Nechaviske	1.9
	Entrances from (O 190510)	
C 190533	to Zavodske	1.2
C 190534	to Dihtiarkaanske	4.1
	Entrances from (O 190506)	
C 190535	to Torgovytsia	1.1
C 190536	to Bilozerka	0.7
C 190537	Entrances from (O 190508) to Bilousivka	2.0
C 190538	Entrances from (O 190511) to Huty	1.6
C 190539	Entrances from (T-19-25) to Shapovalivka	1.3
C 190701	Bilohryve – Khreshchatyk	6.7
C 190702	(T-19-07) – Bilohryve – Vasylykiv district	4.8
C 190703	Pasika – Luch	1.0
C 190704	Obtove – Hubarivshchyna	4.4

C 190705	Bystryk – Kovbasyno	2.0
C 190706	Bystryk – Progress	3.6
C 190707	Kalashynivka – Novoselytsia	5.0
C 190708	Nerovnyne – Buivalove – Svydnia	4.6
C 190709	Terekhove – (M-02)	6.9
C 190710	Entrances from (M-02) to Altynivka	4.0
C 190711	Altynivka – Kalyshynkove – Zaliznychne	3.9
C 190712	Zabolotove – Bozhok – (M-02)	18.0
	Entrances from (C 190712)	
C 190713	to Veseli Hory	2.3
C 190714	to Myrne	0.8
C 190715	to Nerovnyne	0.4
C 190716	Bloodless – Loknya	7.9
C 190717	Entrances from (C 190716) to Yarove	6.5
C 190718	Grechkino – Didivshchyna	5.1
C 190719	Entrances from (M-02) to Retyk	2.5
	Entrances from (T-19-07)	
C 190720	to Peremoha	4.5
C 190721	to Hruzke	1.4
C 190722	to Mostyshche	1.9
	Entrances from (P -60)	
C 190723	to Sribrovshchyna	3.0
C 190724	to Khomenkove	0.7
C 190725	to Kubakhove	0.5
C 190726	to Otrokhove	1.5
	Entrances from (T-19-11)	
C 190727	to Zaruddia	2.2
C 190728	to Kamen	2.7
C 190729	to Lytvynovychi	2.1
	Entrances from (O 190703)	
C 190730	to Hrybane	4.0
C 190731	to Medvedeve	2.1
C 190732	to Zarichchia	1.0
C 190733	Entrances from (O 190702) to Pokrovske	1.1
C 191201	Volokytyne – Shcherbynivka	1.8
C 191202	Strilnyky – Rotivka	4.2
C 191203	Vyazenka – Khovzovka	5.4
C 191204	Entrances from (C 19203) to Roshcha	0.5
C 191205	Revyakyne – Myshutyno	4.5
C 191206	Skunosovo – Korolki – (O 191207)	6.5
C 191207	Latyshivka – Pishkove – (P-44)	2.1
C 191208	(P-44) – Ponyzivka – Shyriayeve– (T-19-20)	7.5
C 191209	Entrances from (C 19208) to SDihtiarkai	1.8

	Honchary	
C 191210	Pyshchykove – Plakhivka – Bobyne	4.6
C 191211	Mazivka – Voronovka	1.7
C 191212	Nova Sloboda – Bunyakyne	6.3
C 191213	Bunyakyne – Gorki	8.4
C 191214	Rivne – Boroshivka	1.5
C 191215	Partizanske – Kruzhok	2.8
C 191217	Yurievo – Ivanivka	4.1
C 191218	Krasnoe Ozero – Chaplyshche	4.5
C 191219	Rivne – Boyaro-Lezhachi	5.1
C 191220	Rev'yakyne – Machulyshche – Voshchynyne – (T-19-21).	10.8
C 191221	(T-19-21) – Orikhivka – Mazivka – (T-19-20)	9.5
C 191222	(P-44) – Mazivka	5.8
C 191223	Entrances from (C 191222) to Soloviove	2.0
C 191224	Entrances from (C 191222) to Pocheptsi	0.2
C 191225	(P-44) – Peresyvky – Krasne Ozero – (O 191204)	8.4
C 191226	Yurievo – Volyntseve	6.0
C 191227	Rev'yakyne – Kozache – Malushyne	12.8
C 191228	Vesele – (T-19-21)	8.0
C 191229	Entrances from (C 191228) to Shulishivka	2.8
	Entrances from (P-44)	
C 191230	to Zinove	0.4
C 191231	to Kharivka	1.8
C 191232	to Knyazivka	1.6
C 191233	to Minakove	0.6
C 191234	to Tovchenykove	1.3
C 191235	to Vegerivka	1.3
C 191236	to Vyatka. Okip	3.6
C 191237	Nova Sharpivka – SDihtiarkaa Sharpivka	1.5
C 191238	(T-19-11) – (C 191237)	1.0
C 191239	to Ivanivske	0.6
C 191240	to Holubkove	1.2
	Entrances from (T-19-20)	
C 191241	to Syromiatnykove	1.6
C 191242	to Knyazivka	0.4
C 191243	to Shyriayeve	0.5
	Entrance from (O 191203)	
C 191244	to Manukhivka	3.9
C 191245	Entrances from (O 191206) to Kubareve	3.1
	Entrances from (O 191204)	
C 191246	to Bilohalysia	2.0
C 191247	to Volyntsiivske	0.8

	Entrances from (O 191206)	
C 191248	to Kahan	1.0
C 191249	to Plotnikovo	1.8
C 191250	Entrances from (C 191220) to Utskove	3.2
C 191251	Entrances from (O 191208) to Buvalyne	0.6
C 191252	Entrances from (O 191210) to Selezniivka	0.8
C 191253	Entrances road from (T-19-21) to Pyliivka	1.2
	Entrances from (T-19-11)	
C 191254	to Chornobryvkyne	1.6
C 191255	Entrances from (T-19-22) to Zozulenne	1.7
C 191256	Entrances from (S 191218) to Kozlivka	4.0
C 191257	Entrances from (O 191208) to Brusky	1.3
C 191258	Entrances from (T-19-20) to Partyzanske	4.0
	Okhtyrka district	
C 190301	Shyrokyi Bereh – (P-45)	1.5
	Entrances from (C 190301)	
C 190302	to Shurove	0.6
C 190303	to Stanychne	1.5
C 190304	Yizdetske – (P-45)	3.8
	Entrance from (C 190304)	
C 190305	to Shyrokyi Bereh	1.1
C 190306	Luhivka – Striletska Pushkarka	3.8
C 190307	Katanske – Berezivka	4.6
C 190308	Yabluchne – Vesele	5.1
C 190309	Vyshevesele – Ridne	5.0
C 190311	to Katerynivka	6.6
C 190312	to Ponomarenky	1.5
C 190313	to Lukashivka	1.5
	Entrance from (O 190301)	
C 190314	to Marakuchka	1.0
	Entrances from (T-19-23)	
C 190315	to Dihtiarkaasivka	2.5
	Entrances from (O 190302)	
C 190316	to Vesele	3.1
C 190317	to Vasylivka	2.0
C 190318	to Vyshyvesele	1.4
C 190319	Kyrykivka – Ryabyna – Yabluchne – Maiske	17.0
C 190320	Sydorova Yarura – Yamne	4.0
C 190321	Bratenytsia – Shevchenkove – (to Ivano Shyychyne)	4.9
C 191101	Grinchenkove – Rozsokhuvate – Hrunka	7.9
C 191102	Hrinchenkove – Pyatkine	2.7
C 191103	Dovdyk – Buro-Rubanivka	5.0

C 191104	Mykolaivka – Husarshchyna.	2.6
	Entrance from (C 191104)	
C 191105	to Karpylivka	1.8
C 191106	Komyshi – Ozera	4.3
C 191107	Komyshy – Sofiyivka – Olenynske	11.8
	Entrance from (C 191107)	
C 191108	to Konovalyk	1.7
C 191109	Mala Pavlivka – Zakabluky	1.7
C 191110	Mala Pavlivka – Buryachyha	1.1
C 191111	Rybalske – Gnylytsia	6.3
C 191112	Bidany – Bandury	1.2
C 191113	Viazove – Skelka	6.0
C 191114	Zhuravne – Popelivshchyna	2.0
C 191115	SDihtiarkaa Ivanivka – Budne – Novostroyne – (O 191106)	11.8
C 191116	Buimerivka – Hai-Moshenka	3.5
C 191117	Pidloevka – Moshenka	2.3
C 191118	Okhtyrka – Mykhaylenkove	4.2
C 191119	Khukhra – Pylivka	2.5
C 191120	(P-46) – Verbove – Vysoke – Kudriave	9.9
C 191121	Shabaltayevo – Vyazovoye – Rybalskoye – Plastiuki	17.3
	Entrances from (T-17-05)	
C 191122	to Neplatyno	1.4
C 191123	to Shchomy	1.6
C 191124	to Dukhovnyche	1.8
C 191125	to Molodetske	1.4
C 191126	to Borzivshchyna	2.0
C 191127	to Doroslavivka	1.3
	Entrances from (T-19-06)	
C 191128	to Dukhovnyche	1.9
C 191129	to Vysoke	1.9
C 191130	to Veselyi Hai	1.1
	Entrances from (T-19-29)	
C 191131	to Zalisne	2.0
C 191132	to Korabelske	2.6
C 191133	to Lytovka	2.6
C 191135	Entrances from (O 191104) to Lyse	0.6
C 191136	Entrances from (O 191103) to Velyke Ozero	1.0
C 191137	Entrances from (O 191105) to Podil	1.0
C 191138	Entrances from (O 191107) to Ovcharenky	1.2
C 191139	Entrances from (O 191111) to Manchychi	1.1
C 191601	Hradske – (H-12)	3.1

C 191602	Entrances from (C 191601) to Bratske	1.0
C 191603	Naberezhne – (H-12)	4.0
C 191604	Boromya – Parkhomivka	4.5
C 191605	Boromya – Vovkiv	6.8
C 191606	Entrances from (C 191605) to Pershotravneve	1.5
C 191607	Boromya – Shevchenkiv Hai	7.1
C 191608	Bilka – Khvoshchova	10.2
C 191609	Entrances from (C 191608) to Novoselivka	1.0
C 191610	Krynychne – (T-19-13)	2.5
C 191611	Liudzha – Kamianka	8.3
C 191612	Skryahivka – Buimer – (T-19-13)	7.1
C 191613	Bilka – Oleksyne	2.3
C 191614	Khmelivets – ZoloDihtiarkaivka – Artemo-Rastivka – Martynivka – Horyaistivka	5.8
C 191615	Mashchanka – Bratske	4.1
C 191616	Pecheny – Savelove	7.6
C 191617	Dernove – Ryabivka	3.8
C 191618	Kamianka – Kamianetske	3.5
	Entrances from (H-12)	
C 191619	to Hrebenykovka	4.1
	Entrances from (T-19-13)	
C 191621	to Zubivka	2.0
C 191622	to Ovodivka	1.9
C 191623	to Tuchne	1.5
C 191624	to Mashkove	4.6
C 191625	to Liudzha	4.0
	Entrances from (O 191601)	
C 191626	to Zhyhaylivka	4.4
C 191627	to Mozkove	0.7
C 191628	Entrances from (T-19-23) to Novoukrainka	1.4
C 191629	Entrances from (O 191605) to Luchka	1.1
	Romny district	
C 190901	Tovsta – Holuby	3.0
C 190902	Beievo – Oleshchenkove	3.0
C 190903	Sai – Rudoman	4.3
C 190904	Berestivka – Yalovyi Okip.	4.9
C 190905	Koliadynets – Kolisnyky	1.4
C 190906	Koliadynets – Velykyi Lis	3.8
C 190907	Kostiany – (O 190905)	4.1
	Entrances from (C 190907)	
C 190908	to Vovkove	2.3
C 190909	to Hreki	0.7
C 190910	Kapustynets – Klyusy	2.7

C 190911	Kapustynets – Dihtiarkaasenko	5.0
C 190912	Divisions – Veselaya Dolina	4.5
C 190913	Synivka – Dovzhyk	7.0
C 190914	Yahanivka – Buhayivka	2.3
C 190915	Ivanivka – Yasnopilshchyna – Kotsupiyivka – Sakhanske.	9.4
C 190916	Stolyarove – Yalovyi Okip	3.0
	Entrances from (T-19-13)	
C 190917	to Lypivske	1.0
C 190918	to Chervonohirka	4.0
C 190920	to Chervona Dolyna	3.0
C 190921	to Vesele	1.5
C 190922	to Chyrvyno	2.0
C 190923	to Halayevets	0.3
C 190924	to Slobidka	3.4
C 190925	to Potopyha	1.0
C 190926	Entrances from (O 190901) to Makiivske	2.0
	Entrances from (O 190903)	
C 190927	to Velyka Luka	1.3
C 190928	to Kolomyitsia Dolyna	3.6
C 190929	Entrances from (T-19-04) to Bukhalove	3.0
	Entrances from (O 190906)	
C 190930	to Novosemenivka	2.0
C 190931	to Karptsi	1.5
C 190932	to Nesterenky	1.6
C 190933	to Hryshky	1.5
	Entrances from (O 190907)	
C 190934	to Arshuky	0.7
C 190935	to Khomenkove	0.5
C 190936	to Melnykove	1.5
C 190937	to Peremoha	2.5
C 191001	Terny – Cherepovets	4.2
C 191002	Terny – Hostryi Shpyl	4.9
C 191003	Terny – Kholodne	8.1
C 191004	Hrynivka – Nelyny	5.3
C 191005	Bizh – (O 191004)	6.1
	Entrances from (C 191005)	
C 191006	to Omelkove	2.1
C 191007	to Lavrove	0.8
C 191008	Kosenky – Korotyshche	6.6
C 191009	Tomashivka – (C 191008)	2.8
C 191010	Basivka – Zakroyivshchyna	0.5
C 191011	Small Booths – (O 191007)	2.0

C 191012	Besedivka – Kulishivka	6.7
C 191013	Pushkarshchyna – Chervona Sloboda – Gorkove	11.1
C 191014	Entrances from (O 191006) to Brodok	2.2
C 191015	Yukhty – Korovyntsi – Hai – Rakova Sich	13.0
	Entrances from (C 191015)	
C 191016	to Sosnivka	2.4
C 191017	to Borodanovo	0.8
C 191018	to Shkroboti	3.8
C 191019	to Yukhta	0.2
C 191020	Kulishivka – Kostiantyniv – Kurmany – (H-07)	7.1
C 191021	Kurmany – Berezniaky – (H-07)	4.8
C 191022	Derkachivka – Horodyshche	3.3
C 191023	Dihtiarka – (T-19-04)	9.0
	Entrances from (C 191023)	
C 191024	to Tsybulenky	2.4
C 191025	to Berizky	1.0
C 191026	Dremove – Tereshky – (T-19-04)	5.0
C 191027	Zasulia – Koreneve	7.0
C 191028	Zelenkivka – Sorokolitove	3.0
C 191030	Vilshana – Biloyarske – Nemudrui	7.1
C 191031	Filonove – Vesnohirske	5.0
C 191032	Vihove – Luki	3.0
C 191033	Lakhnivshchyna – Peretychky	4.2
C 191034	Zasulia – Brodok	3.0
C 191035	Marshaly – Bizh	3.0
C 191036	Entrances from (H-07) to Vakulky	0.6
C 191037	Entrances from (P-61)	
	to Shmatove	3.0
C 191038	to Volodymyrivka	3.0
	Entrances from (T-19-04)	
C 191039	to Dolyna	4.8
C 191040	to Mazne	1.9
C 191041	to Darahanove	1.8
C 191042	to Velyka Dibrova	1.6
	Entrances from (T-19-26)	
C 191043	to Chertsy	2.5
C 191044	to Havryky	2.3
C 191045	Entrances from (O 191004) to Spartak	1.0
	Entrances from (O 191007)	
C 191046	to Tymoshchenkove	1.2
C 191047	to Tyutyunnykove	1.2
	Entrances from (O 191008)	
C 191048	to Shapovalove	1.0

C 191049	to Fartushino	0.8
C 191050	to Khorol	3.0
C 191051	Entrances from (O 191009) to Klyn	2.7
	Entrances from (T-19-26)	
C 191052	to Likarivshchyna	0.8
C 191053	to Pyatydub	0.6
C 191054	to Kynashove	1.8
	Entrance from (O 191006)	
C 191055	to Mazepyni Hory	0.5
C 191056	road in Khoruzhivka	16.9
C 191301	Pluzhnykove – Galka – Velyki Bubny	16.9
C 191302	Dibrova – Volodymyrivka – Khreshchatyk – Kosarivshchyna	11.5
C 191303	Entrances from (C 191302) to Fedotove	0.8
C 191304	Mykolaiivka – Kalynivka	3.6
C 191305	Mykolaiivka – Horove	4.0
C 191306	Smile – Chervone	5.6
C 191307	Pogozha Krynytsia – Halenkove – (T-19-13)	7.6
C 191308	Zaruddia – Chervonogvardiyske	5.2
C 191309	Velyki Bubny – Matlakhove	5.7
C 191310	Basivka – Zakroyivshchyna	4.4
C 191311	Havrylivka – Korolivshchyna – Mykolaiivske	10.1
C 191312	Entrances from (C 191311) to Chyzhykove	1.6
C 191313	(H-07) – Havrylivka – Nenadiyvka – (H-07)	15.1
C 191314	Bilovod – Popivka	2.4
C 191315	Zalatykha – Holinka	6.6
C 191316	Perekhrestivka – Savoyske – (O 191302)	5.5
C 191317	Entrances from (C 191316) to Malyarivshchyna	1.5
C 191318	Boikove – (T-19-13)	6.1
C 191319	Popovshchyna – (O 191312)	3.0
C 191320	Anastasivka – Novopetrivka	3.6
C 191321	Chyste – Bratske – Vasylivka	4.2
C 191322	Mykolaiivka – (P-60)	5.3
C 191323	(O 191309) – Voloshnivka – Yaroshivka	9.1
C 191324	Perekhrestivka – Pohorazha Krynytsia – Zaruddia – Velyke	15.2
C 191325	Entrances from (C 191324) to Stepuryno	2.2
C 191326	Andriivka – Kholodnyk	5.0
	Entrances from (H-07)	
C 191328	to Mali Bubny	2.9
C 191329	to Batsmani	1.8
C 191330	to Kropyvintsy	2.0
C 191331	to Dovhopolivka	1.8

C 191332	to Levchenky	1.9
C 191333	to Moskovshchyna	2.1
C 191334	to Herasymivka	0.8
C 191335	to Zinove	2.8
	Entrances from (P-60)	
C 191336	to Kasyanove	3.9
C 191337	to Zaklymok	1.1
C 191338	to Perekopivka	2.0
C 191339	to Hubske	2.9
C 191340	to Burbyne	2.1
	Entrances from (T-19-13)	
C 191341	to Perekhrestivka	5.6
C 191342	to Ziuziuki	0.8
C 191343	Entrances from (O 191301) to Novytske	5.2
	Entrances from (O 191302)	
C 191344	to Novokalynivka	0.3
C 191345	to Lukasheve	0.9
C 191346	to Yakymovychi	0.9
C 191347	to Svitivshchyna	3.2
	Entrances from (T-19-16)	
C 191348	to Zhytne	1.4
C 191349	to Pohreby	2.2
C 191350	to Ripky	2.0
C 191351	to Mokiivka	1.8
C 191352	Entrances from (O 191306) to Viunne	1.8
	Entrances from (O 191307)	
C 191353	to Zalutske	2.0
C 191354	to Voschylykha	2.0
C 191355	to the Staikin Verkh tract (Posulia Kurgan group)	1.2
C 191356	to Pshynchynе and the Scythian settlement	2.8
C 191357	to Zarichchia	2.2
C 191358	to Velyka Butivka	0.6
	Entrances from (O 191308)	
C 191360	to Pisky	4.0
C 191361	to Sadove	2.3
C 191362	to Zelenivshchyna	4.5
C 191363	to Surmachivka	3.3
C 191364	to Zarudnivka	2.3
C 191365	to Melnyky	2.0
C 191366	Entrances from (O 191310) to Nova Hreblya	5.5
	Entrance from (O 191312)	
C 191367	Entrance to Markivske	0.4
C 191368	Entrance to Veselyi Step	0.3

	Entrance from (O 191313)	
C 191369	Entrance to Shylyvske	1.0
C 191370	The entrance to Kononenkove	0.7
	Sumy district	
C 190101	Golyshivske – Budky	2.0
C 190102	Stari Vyrky – Babakivka	7.7
C 190103	Iskryskivchyna – Bezsaliivka	3.2
C 190104	Iskra – Neskuchne – Volfyne	7.5
C 190105	Pavlivka – Volfine	7.1
C 190106	Entrances from (C 190105) to Shpyl	3.0
C 190107	Obody – Makiiivka	3.0
C 190108	Cherevativka – Shkurativka – Nahirnivka	6.6
C 190109	Kalchenky – Krasne	4.0
C 190110	Suprunivka – Mykolaivka – Ternivska	9.8
C 190111	Entrances from (C 190110) to Hezivka	2.0
C 190112	Suprunivka – Bilykivka – Ruda	7.1
C 190113	Entrances from (C 190112) to Pershotravneve	2.3
C 190114	Novopetrivka – Chervonivka	2.7
C 190115	Horobivka – Omelchenky	5.0
C 190116	Kandybino – Olekseny	2.5
C 190117	Gurynivka – Vasyliyshchyna	0.8
C 190118	Kysla Dubyna – Hurynivka – Morocho – Marianivka	10.9
C 190119	Morocho – Stepanivka.	2.0
C 190120	Richky – Bayikha	4.0
C 190121	Tuchne – Oleksandrivka	2.6
C 190122	Mashari – Kurasovo	1.0
C 190123	Sulsk – (H-07)	5.1
C 190124	Lokhnya – Mukiyivka	2.2
C 190125	Mykolaivka – Streltseve	4.0
C 190126	Mykolaivka – Vylki	5.0
C 190127	Markivka – Rudka	2.0
C 190128	Korshachyna – Kalynivka	9.0
C 190129	Butovshchyna – Arkavske	1.5
C 190130	Entrances from (C190129) to Shevchenkivka	1.5
C 190131	Korshachina – Sinyak	4.0
C 190132	Lutsykivka – (T-19-06)	3.5
	Entrances from (P-44)	
C 190133	to Zelene	1.7
C 190134	to Kravchenkove	2.5
C 190135	to Maksymivshchyna	2.0
C 190136	to Novi Vyrky	2.1
	Entrances from (P-61)	

C 190137	to Pishchane	1.5
C 190138	to Staroziniv	3.0
C 190139	to Vesele	1.0
C 190140	to Zholobok	1.0
	Entrances from (T-19-06)	
C 190141	to Sokhani	1.5
C 190142	to Smolyanykivka	3.0
C 190143	to Bolotysche	1.2
	Entrances from (T-19-04)	
C 190144	to Tsymbalivka	1.1
C 190145	to Hannivske	1.8
	Entrances from (O 190101)	
C 190146	to Melyachykha	2.3
C 190147	to Myrlogy	2.2
	Entrances from (O 190104)	
C 190148	to Dudchenky	3.0
C 190149	to Bezsokyrne	2.4
	Entrances from (O 190105)	
C 190150	to Tereshchenky	4.0
C 190151	to Lidyne	1.0
	Entrance from (O 190106)	
C 190152	to Novoivanivka	1.0
C 190153	Entrances from (O 190102) to Pavlenkove	1.0
C 190154	Entrances from (O 190103) to Stukalivka	5.0
C 190155	Entrances from (C190132) to Ptyche	0.4
C 190601	Sinne – Barylivka.	4.4
C 190602	Mala Rybytsia – Velyka Rybytsia	9.6
C 190603	Myropillya – Oleksandria	2.3
C 190604	Osoyvka – Marchenky	5.5
C 190605	Uhroidy – Turya – Maryine	13.6
C 190606	Entrances from (C 190605) to Myropilske	4.5
C 190607	Uhroidy – Naumivka	2.8
C 190608	Samotoivka – Voropai	7.0
C 190609	Samotoivka – Dumivka	4.4
C 190610	Hrabovske – Pokrovka – Stepok.	23.0
C 190611	Velykyi Bobryk – Yusupivka	2.5
C 190612	Samotoivka – Chernechyna – Vydnyvka	11.0
C 190613	Khmelivka – Vesele	4.2
C 190614	Lozove – (P-45)	7.6
C 190615	Porozok – Verkhnya Poznya	1.2
C 190616	Entrances from (P-45) to Novooleksandrivka	2.0
C 190617	Entrances from (T-19-13) to Brantsivka	2.3
	Entrances from (O 190601)	

C 190619	to Mozkove	0.7
C 190620	to Haponivka	2.7
C 190621	to Yasenok	3.4
C 190622	to Ivakhnivka	1.2
	Entrances from (T-19-01)	
C 190623	to Velykyi Prykil	4.1
	Entrance from (O 190604)	
C 190624	to Petrushivka	3.0
C 190625	to Okip	1.1
	Entrances from (T-19-18)	
C 190626	to Mykhailivske	1.9
C 190627	to Mykhailivka	3.5
C 190628	to Krasnopillia station	1.8
C 190629	Entrances from (O 190605) to Lisne	1.6
C 190630	Entrances from (O 190603) to Kamiane	0.3
	Entrances from (C 190610)	
C 190631	to Popivka	0.1
C 190632	to Vysoke	0.7
C 190633	Entrances road from (O 190607) to Mayske	1.5
C 190634	Zaliznyak – Khvoine	0.4
C 190635	Entrances from (O 190608) to Novodmytrivka	1.9
C 190801	Pidopryhory – Dmytrivka – (H-07)	18.5
C 190802	Boyky – Bukaty	3.7
C 190803	(T-19-06) – Pavlenkove – Sloboda – Bukaty	6.6
C 190804	Vorozhba – Lyfyne – Basivshchyna	12.5
	Entrances from (C 190804)	
C 190805	c. Lobodivshchyna	1.5
C 190806	c. Khilkove	0.5
C 190807	Vorozhba – Kerdylivshchyna	2.4
C 190808	Katerynivka – Oleksiivka	2.0
C 190809	Hrytsyny – Halushky – Maidaky	3.4
C 190810	Shtepivka – Martyntsi – Digtyari	2.2
C 190811	Chyzhove – Hrusheve	4.0
C 190812	Chervlene – Novoselivka.	5.6
C 190813	Budyłka – Zelenyi Hai	12.9
C 190814	Kamiane – Chernyshky	3.2
C 190815	Moskovsky Bobrik – Bereziv Yar	5.0
C 190816	Moskovsky Bobryk – Vlizky – (T-19-06)	19.5
	Entrances from (C 190816)	
C 190818	to Burivka	0.8
C 190819	to Semenivka	0.5
C 190820	Hudymivka – Topchya	3.5
C 190821	Kalyuzhne – Korchany	7.6

C 190822	Entrances from (C 190821) to Liashky	1.2
C 190823	Kalyuzhne – Radchuky	5.3
C 190824	Kalyuzhne – Cheremukhivka	5.2
C 190825	Ryabushki – Kurylivka – Pivdenne	10.7
C 190826	Garbuzivka – Sitnyky	3.5
C 190827	Hramyno – Holubivka – Holobury – Mezhyrich – Tokari – (T-19-06).	31.8
C 190828	Kurhan – Chervlene	5.2
C 190829	Nyzhnia Syrovatka – Velykyi Vystorop – Malyi Vystorop	15.1
C 190830	Nyzy – Velykyi Vystorop.	4.3
C 190831	Velykyi Vystorop – Revky	13.0
	Entrances from (H-07)	
C 190832	to Pidsulia	1.0
C 190833	to Novopetrivka	1.0
C 190834	to Gamaliyivka	1.0
C 190835	to Kliuchynivka	2.0
C 190636	to Shtepivka	2.5
C 190837	to Filonivshchyna	1.0
	Entrances from (T-19-06)	
C 190838	to Hutnytske	0.5
C 190839	to Garbari	1.0
C 190840	to Kulychka	2.0
C 190841	to Sofiyivka	3.2
C 190842	to Hrabtsi	0.7
	Entrances from (T-19-09)	
C 190843	to Valky	0.6
C 190844	to Piskivka	0.9
C 190845	to Stupky	1.5
C 190846	to Datsenkivka	2.4
C 190847	to Kudanivka	1.1
	Entrances from (T-19-13)	
C 190848	to Shevchenkove	0.6
C 190849	to the Korchanka tract	1.6
C 190850	to Oleksenkove	0.4
C 190851	to Kostiv	0.5
	Entrances from (O 190801)	
C 190852	to Kulhky	1.6
C 190853	to Pletneve	1.0
C 190854	to Myrne	2.0
C 190855	to Pomyrky	2.0
	Entrances from (O 190802)	
C 190856	to Panchenky	1.0

C 190857	to Yaroshi	0.5
C 190858	to Karavan	1.7
C 190859	to Ovdianske	1.5
	Entrances from (C 190827)	
C 190860	to Derkach	1.0
C 190861	to Kolomyitsi	1.5
C 190862	Entrances from (O 190803) to Stepne	0.5
	Entrances from (T-19-26)	
C 190863	to Myronivshchyna	0.5
C 190864	to Kliuchynivka	1.3
	Entrances from (O 190808)	
C 190865	to Pershotravneve	1.0
C 190866	to Bayrak	1.6
C 190867	to Shumyly	2.0
C 190868	to Parfily	1.6
C 190869	Entrances from (O 190805) to Barabashivka	1.0
C 190870	Entrances from (C 190831) to Staronove	4.2
C 190871	Entrances from (T-19-06) to Mezhyrich	8.2
C 191501	Novomykolaivka – Bilovody – Zhuravka	11.6
C 191502	Novomykolaivka – Volodymyrivka – state border	4.9
C 191503	Yunakivka – Basivka – Novenke	12.2
C 191504	Yunakivka – Sadky	6.2
C 191505	Oleksiivka – Andriivka.	5.0
C 191506	Stetskivka – Rybtsi – Bytysia	12.9
C 191507	Bytysia – Mykilske	5.2
C 191508	Bytysia – Vakalivshchyna	3.5
C 191509	Pushkarivka – Zelenyi Hai	3.0
C 191510	Zatsarne – Bezdryk – (H-12)	8.8
C 191511	Mykolaivka – Kapitanivka	6.5
	Entrance from (C 191511)	
C 191512	to Spaske	1.1
C 191513	Sofiyivka – Sklyarivka	1.2
C 191514	Severinivka – Maryivka – (P-44)	4.1
C 191515	Stepanivka – Sievierivka – Rohizne	8.1
C 191516	Stepanenkove – Holovashivka	2.7
C 191517	Krasny Kut – Pidlisnivka – Bilousivka	5.7
C 191518	Novosukhanivka – Krasnyi Kut	2.4
C 191519	Novosukhanivka – Mylovydivka – Pidlisnivka	8.5
C 191520	Pidlisnivka – Oleksandrivka	1.8
C 191521	Tereshkivka – Pechyshe – (H-07)	12.0
C 191522	Entrances from (C 191521) to Butsykove	1.5
C 191523	Entrances from (O 191508) to Perekhrestove	1.1
C 191524	Entrances road from (O 191509) to Nadtochievo	1.0

C 191525	Moskaliivshchyna – Yaseny – Yelyseienkove	5.1
C 191526	Shpylivka – Vyzyrivka	5.4
C 191527	Shpylivka – Kharkiv region	2.2
C 191528	Sumy – Novoselytsia	1.0
C 191529	Nyzhnya Syrovatka – Maliy Vystorop – Byshkin	6.9
C 191530	Nyzy – Velykyi Vystorop	5.0
C 191531	Stare Selo – Luhove	6.6
C 191532	Entrances from (C 191531) to Vyshneve	1.8
C 191533	(P-44) – Hrytsenkove	2.0
C 191534	Bezdryk – Zakharivske	3.4
C 191535	Kosivshchyna – Sad`	3.5
C 191536	Pidlisnivka – Novomykhailivka.	1.8
	Entrances from (H-07)	
C 191537	to Zelena Roscha	1.8
C 191538	to Dotsenkivka	1.6
C 191539	to Symonivka	1.5
C 191540	to Velyki Vilmy	2.5
C 191541	to Velykyi Yar	1.1
C 191542	to Nykontsi	3.2
C 191543	to Liubacheve	1.5
C 191544	to Sad	1.7
C 191545	to the Seed Station	0.9
C 191546	to Shevchenkove	1.6
C 191547	to Kardashivka	1.5
C 191548	to Stetskivka	1.5
C 191549	to Korchakivka	3.6
C 191550	to Nova Sich	2.0
C 191551	to Loknya	2.2
	Entrances from (O 191513)	
C 191552	to Nadyarne	1.9
C 191553	to Verbove	0.9
C 191554	Entrances from (H-12) to Hirne	1.0
	Entrances from (P-45)	
C 191555	to Zaliznyak	2.4
	Entrances from (P-44)	
C 191556	to Vasyukivshchyna	1.0
C 191557	to Lantvarivka	1.0
C 191558	to Sokolyne	1.0
	Entrances from (P-61)	
C 191559	to Hlyniane	1.8
C 191560	Entrances from (T-19-09) to Oblohy	1.2
C 191561	Entrances from (O 191503) to Burchak	2.1
C 191562	Entrances from (O 191515) to Likarske	2.5

	Entrances from (O 191502)	
C 191563	to Bondarivshchyna	1.6
C 191564	to Dibrova	1.7
C 191565	Entrances road from (T-19-01) to Khomyne	1.1
C 191566	Entrances from (C 191501) to Veselivka	2.9
C 191567	Entrances from (O 191504) to Mala Korchakivka	1.0
	Entrances from (O 191509)	
C 191568	to Kononenkove	2.0
C 191569	to Zakumske	2.0
C 191570	Entrances from (O 191512) to Barvinkove	2.7
	Entrances from (O 191511)	
C 191571	to Brovkove	0.5
C 191572	to Opolonske	1.9
C 191573	Entrances from (O 191505) to Kindrativka	1.5
C 191574	Zaliznyak – Khvoyne	3.1
	Shostka district	
C 190401	(M-02) – Pustohorod – Smolyne	8.7
C 190402	Shakutiivshchyna – (T-19-15)	5.0
C 190403	Zemlianka – Guta	8.0
C 190404	Dunayets – Shchebry	3.5
C 190405	Dunayets – Sutiski	5.1
C 190406	Semenivka – Ionine	3.5
C 190407	Kravchenkove – Kalyuzhne – (P-44)	3.3
C 190408	Petropavlivska Sloboda – Budyshcha – (P-44)	7.0
C 190409	Budivalne – Bilokopytove	2.5
C 190410	Esman – Luzhki – (M-02)	7.0
C 190411	Vilna Sloboda – Mala Slobidka	1.9
C 190412	Koreniok – Sukhodil – Topolia	12.0
C 190413	Entrances from (C 190412) to Chervonyi Pakhar	1.5
C 190414	Ulanove – Komarivka	4.5
C 190415	Ulanove – Bobylivka – Chervona Zorya	12.2
	Entrances from (C 190415)	
C 190416	to Bila Bereza	2.0
C 190417	to Sydorivka	3.0
C 190418	c. Sopych – Potapivka	4.7
C 190419	Shalygyne – Starykove	5.0
C 190420	Shalygyne – Khodyno – Vovkivka	11.2
C 190421	Entrances from (C190420) to Yemadykyne	0.7
C 190422	Esman – Kucherivka – Kharkivka	17.5
	Entrances from (M-02)	
C 190423	to Godunivka	1.6
C 190424	to Khotmynivka	2.0
C 191125	Entrances from (P-44)	

	to Matskove	2.5
C 190426	to Nekrasove	5.2
	Entrances from (O 190403)	
C 190427	to Masenzivka	0.8
C 190428	to Zhalkivshchyna	4.0
C 190429	to Pershe Travnia	3.0
C 190430	to Esman station	1.0
C 190431	Entrances from (O 190404) to Vyshenky	1.5
C 190432	Entrances from (O 190410) to Popivshchyna	1.9
C 190433	Entrances from (O 190415) to Chernivske	1.0
C 190434	Entrances from (O 190413) to Moskalenky	1.5
C 191401	Krenydivka – Znob-Trubchevska – Ulytsia	17.7
	Entrances from (C 191401)	
C 191402	to Liubakhove	1.9
C 191403	to Khudoyarove	2.2
C 191404	Mefodivka – Chetvertakove	3.0
C 191405	Golubivka – Poliske	4.0
C 191406	Golubivka – Zarichchya	1.1
C 191407	Yasnaya Polyana – Troitske	0.4
C 191408	Zarechne – Rudak	2.5
C 191409	Kryvonosivka – Taborishche	1.9
C 191410	Zhykhove – New Sparta	4.5
C 191411	Pyharivka – Luh	3.5
C 191412	Pyharivka – Rih	7.5
C 191413	Romashkove – Demchenkove	2.7
C 191414	Entrances from (C 191413) to Lisova Polyana	1.0
C 191415	Sorokyne – Progress	1.5
C 191416	Sorokyne – Shalymivka	4.7
C 191419	Rozhkoviychi – Sytne	6.4
C 191420	Znob-Trubchevske – Znob-Novhorodske	3.0
C 191421	Stiahailivka – Liute	1.2
C 191422	Velyka Berizka – Pyharivka – Chernatske	15.1
C 191423	Chernatske – Romashkove	4.0
C 191424	Novovasylivka – Vasylivske	5.8
C 191425	Entrances from (T-19-08) to Kustyne	1.2
	Entrances from (O 191402)	
C 191426	to Krasnoyarske	2.3
C 191427	to Boroviychi	2.7
C 191701	Klyshky – Kholodovshchina	5.9
C 191702	Sobych – Lisne	4.3
C 191703	Klyshky – Solotvyno – Velyki Lis.	7.0
C 191704	Pohrebky – Svirzh	2.8
C 191705	Myronivka – Krupets	4.8

C 191706	Myronivka – Shkirmanivka	2.7
C 191707	Shostka – Gukove	6.8
C 191708	Entrances from (P-65) to Makove station	1.3
C 191709	Entrances from (T-19-07) to Voronezh station	0.5
C 191710	Entrances from (O 191705) to Chorni Lozy	2.6
C 191711	Shatrishche – Vovna – (T-19-08)	6.8
C 191712	Bohdanka – Kovtunove – (O 191705)	4.5
C 191713	Chapliyivka – Tymanivka – Benzyky	18.6
C 191801	Stepne – Feofilivka	4.6
C 191802	Entrances from (C 191801) to Mayske	2.6
C 191803	Baselivschyna – (O 191802)	6.0
C 191804	Doroshivka – Kosynske – Palashchenkove	3.3
C 191805	Chuykivka – Mykytske	4.7
C 191806	Marchykhyna Buda – Rudenko	2.5
C 191807	Marchykhyna Buda – Radionivka – Lomlenka.	7.2
C 191808	Marchykhyna Buda – Demianivka	5.0
C 191809	Knyazhychi – Veselyi Hai	6.8
C 191810	Knyazhychi – Orliv Yar	5.2
C 191811	Knyazhychi – Zoryne – Zelena Dibrova	12.5
C 191812	Vozdvyzhenske – Hovorunove	3.3
C 191813	Yampil – Prudyshe – Papirnya	8.6
	Entrances from (C 191813)	
C 191814	to Rostov	1.1
C 191815	to Olhynе	2.6
	Entrances from (T-19-15)	
C 191816	to Doroshenkove	1.9
C 191817	to Dovzhyk	1.4
C 191818	to Vasylets	1.0
C 191819	to Chyzykove	0.6
C 191820	to Nepliyeve	3.5
C 191821	to Okip	0.7
C 191822	to Dibrova	2.4
	Entrances from (O 191804)	
C 191823	to Rozhdestvenske	1.6
C 191824	to Sorokovyi Klyn	3.1
	Entrance from (O 191806)	
C 191825	to Buhor	1.0
C 191826	Entrances from (O 191805) to Skobychivske	0.5
C 191827	Shatrishche – Vovna – (T-19-08)	4.6
	Total of district roads	2665.8

Scientific edition

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