S&E

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The Era of Great Transformation
: Crisis Response and Strategies for Future Land Development

Commemorating KRIHS's 46th Anniversary

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Korea Research Institute for Human Settlements · 국토연구원

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01 Megatrends and Prospects for the National Territory's Future

Wooseong Jeong

1. The Rationale for National Territory Future Projections

The domestic and international landscapes surrounding Korea are experiencing rapid and complex changes due to various factors, leading to increased uncertainty in future forecasts. As a result, the importance of forecasting is becoming increasingly critical. As shown in the figure below, future forecasting involves identifying the gap between the probable future and the preferable future (the outcome we aim to achieve) and bridging this gap to establish a desirable future trajectory for the nation. This process also inspires current changes aimed at realizing that vision. Governments engage in activities to anticipate diverse potential futures, define strategic goals for the nation's future, and prioritize or implement institutional innovations to achieve these goals (Park, S. & Song, Y., 2019).

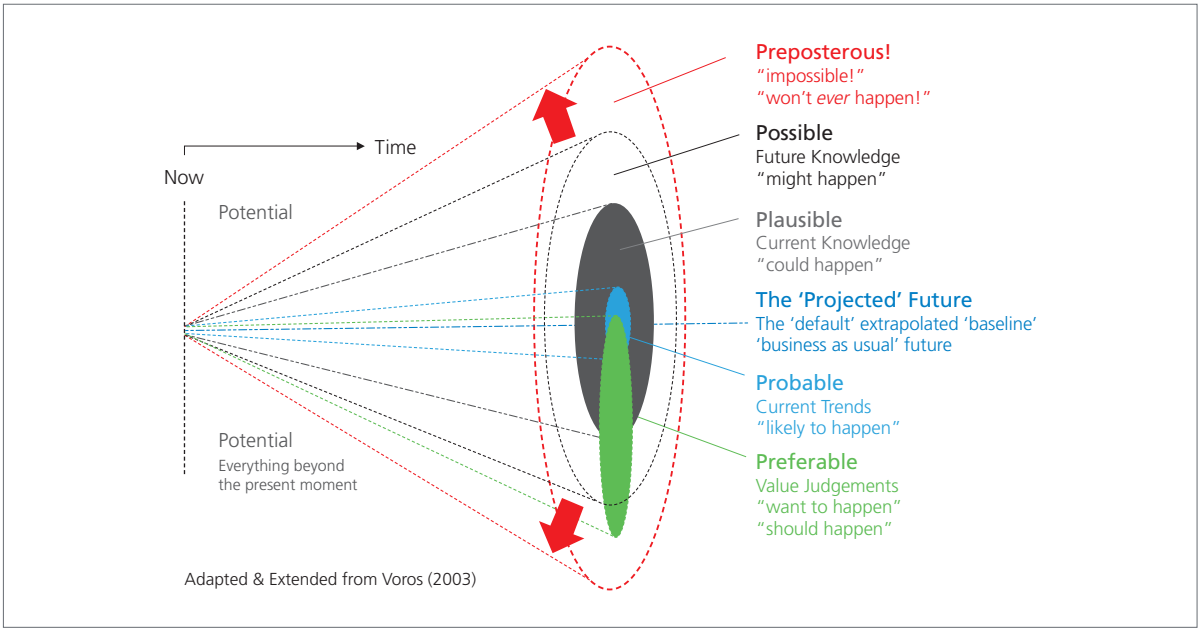
This article explores the megatrends shaping our future and examines their potential effects on national land development. It also highlights examples of scenario-based strategies and discusses the challenges of strategic planning in navigating these complex dynamics. Figure 1

2. Megatrends and Policy Issues in National Territory and Transportation Sector

1) Population Risk and the Local Extinction Crisis

The population sector is currently experiencing significant megatrends, including the transition to an ultra-aged society, the increasing prevalence of single-person households, and the exacerbation of regional disparities due to population concentration in capital areas. The rate of population decline is expected to accelerate, reaching -0.8% by 2050 and -1.24%

Figure 1. The Futures Cone

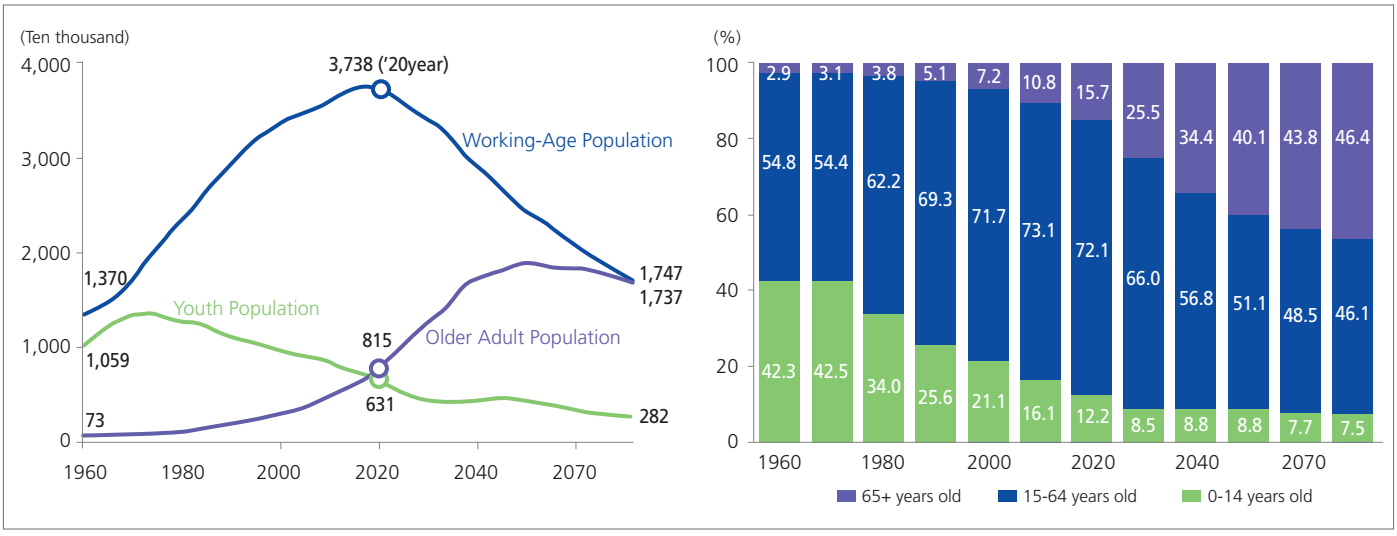


Source
Voros, J (2003)

by 2070. The total fertility rate, recorded at 0.72 in 2023 (the lowest globally), has contributed to transforming the population structure into an inverted pyramid, with a disproportionately large older adult population. This shift will usher Korea into an ultra-aged society by 2025. Additionally, single-person households are anticipated to become the predominant household type, owing to declining marriage rates and changes in societal norms. The working-age population is projected to shrink, comprising only 51.1% of the total population by 2050. On a regional level, while Sejong and Gyeonggi are expected to see population increases by 2052 compared to 2022, the remaining 15 provinces face a continuous population decline. Busan, Gyeongnam, Daegu, and Ulsan are forecasted to experience population reductions exceeding 20% during this period (Statistics Korea, 2024). Figure 2, Figure 3

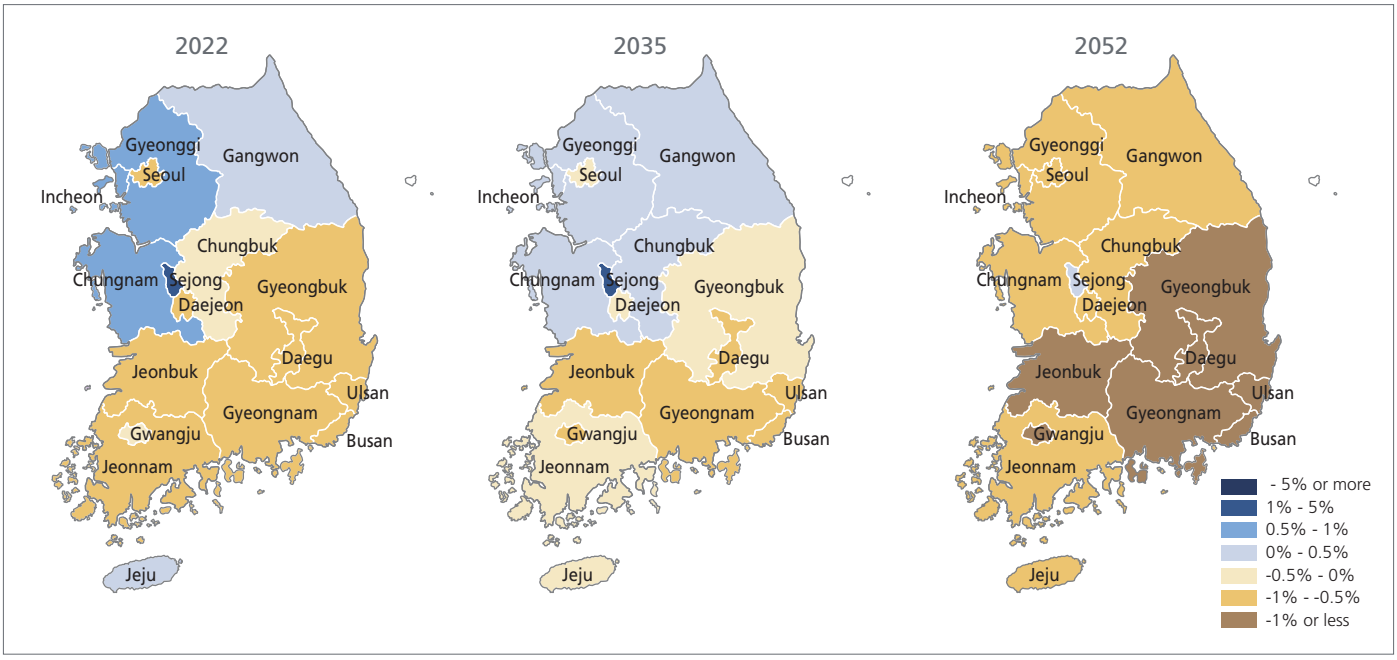
As a result of these demographic changes, several new trends are expected to emerge. First, spatial disparities will likely increase, including a decrease in development demand in the land sector, a slowdown in regional population migration rates, widening gaps between urban centers, and the expansion of

Figure 2. Demographics and demographic composition by age, 1960-2070 (median)



Source Statistics Korea (2024)

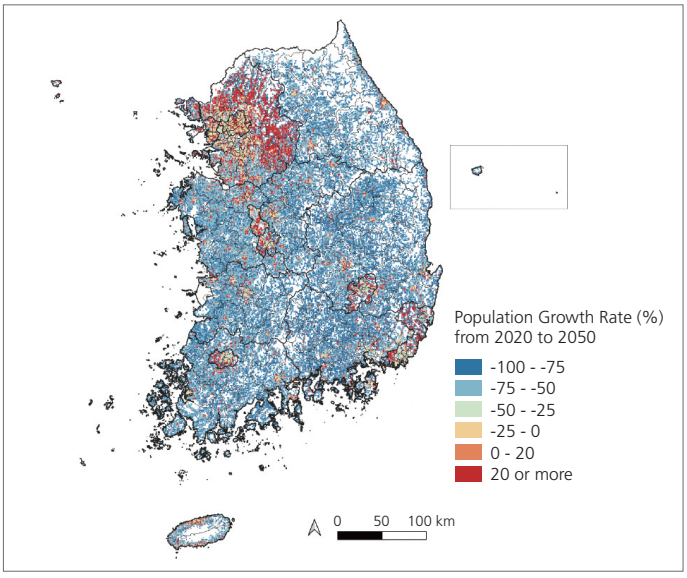
Figure 3. Population growth by city and province



Source Bank of Korea (2023)

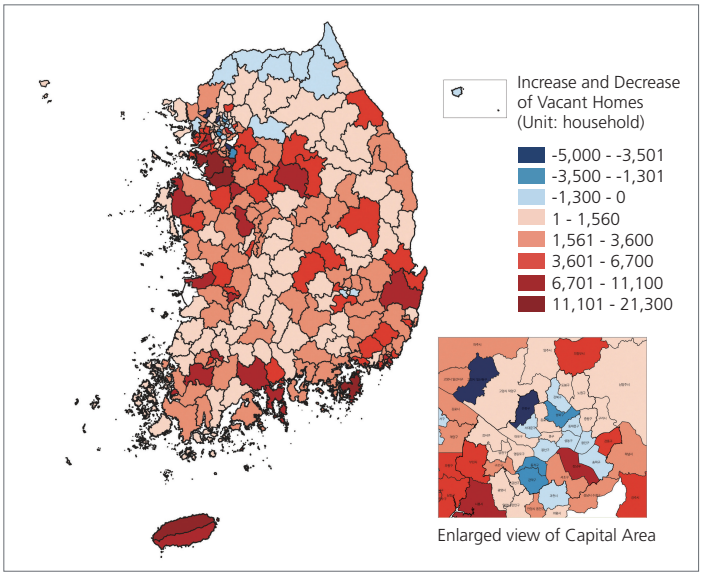
non-residential and underpopulated areas. Despite the overall population decline, the continued concentration of people in the capital area is likely to give rise to "super metropolitan areas," while rural regions will experience intensified polarization, resulting in "declining cities." Second, the number of vacant houses is projected to steadily increase, particularly in the outskirts of metropolitan areas and regions with declining populations, necessitating special management strategies

Figure 4. Changes in population growth rate from 2020 to 2050



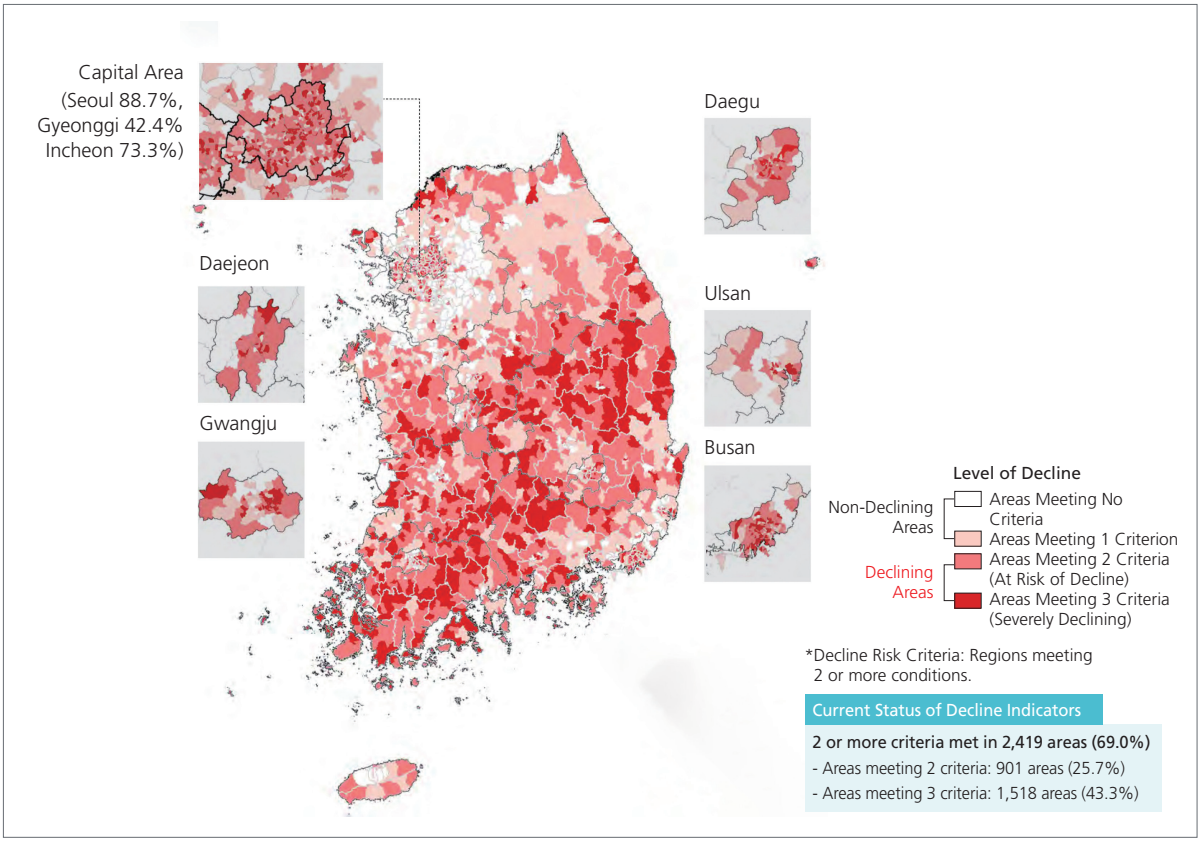
Source Lee, B et al (2022)

Figure 5. Increase and decrease of vacant homes by city and districts nationwide (2010-2018)



Source Korea Research Institute for Human Settlements (2019)

Figure 6. Declining areas at the national level



Source
Korea Research Institute for Human Settlements (2019)

to address this growing national challenge. Third, regional disparities in urban settlement conditions are likely to deepen. The national decline level, measured between 2013 and 2017, illustrates this disparity: metropolitan areas deteriorated at a rate of 11.8%, while provincial areas declined by 3.2%. By 2017, the overall national decline rate had intensified compared to 2013 (rising from 64.5% in 2013 to 69% in 2017). Fourth, demographic changes are expected to reshape land values and societal priorities. New considerations such as environmental quality, safety, and happiness are becoming central to land policy discussions. Age-friendly policies will become increasingly critical to accommodate the growing older adult population. Additionally, the emergence of the MZ generation as a dominant demographic necessitates innovative approaches to urban planning and land management. Figure 4, Figure 5, Figure 6

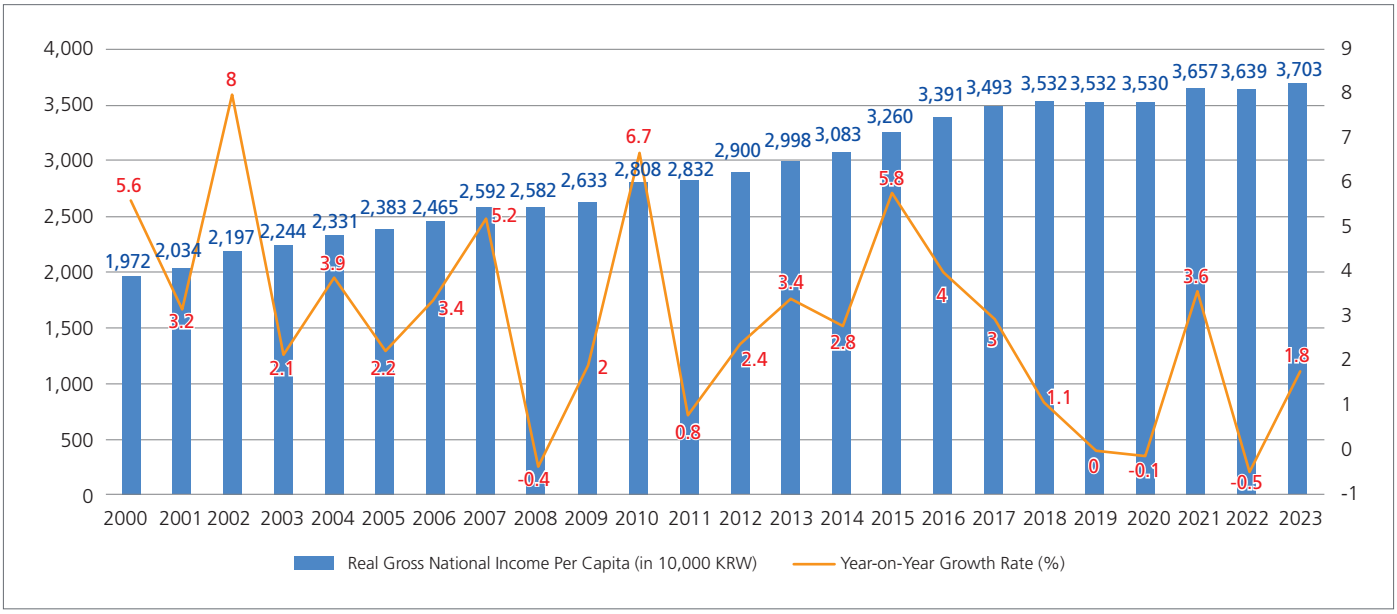
2) Stagnant Economic Growth and Crisis in Regional Industrial Cities

First, South Korea is grappling with stagnant low economic growth. The nation's potential real GDP per capita growth rate is expected to decrease from 1.9% during 2020–2030 to 0.8% between 2030–2060. Since 2010, Korea's economic growth rate has remained in the low 2–3% range, and dropped to -0.9% in 2020 as a result of the economic disruptions caused by Covid-19. Second, global economic uncertainty is increasing. The prolonged effects of the pandemic have led to a persistent global recession and entrenched inequality. However, alongside these challenges, the rise of the platform economy—also known as the "sharing economy" and "gig economy"—has emerged as a transformative business model. Unlike traditional pipeline companies, platform-based enterprises require minimal material investment and achieve rapid success through digital platforms. This economic trend is driving significant structural shifts, particularly with the concentration of innovative growth companies in metropolitan areas. Additionally, manufacturing firms in technology-intensive sectors that rely on human and knowledge capital are becoming more centralized in urban hubs. At the same time, regional industrial cities face compounding pressures. The aging and deterioration of facilities such as national infrastructure and industrial complexes are accelerating, highlighting the urgency for efficient maintenance and renewal. However, this need arises amidst shrinking capacities for infrastructure-related financial investments, presenting a critical challenge to sustaining economic vitality in these areas. Figure 7, Figure 8

3) Technological Innovation and Digital Transformation

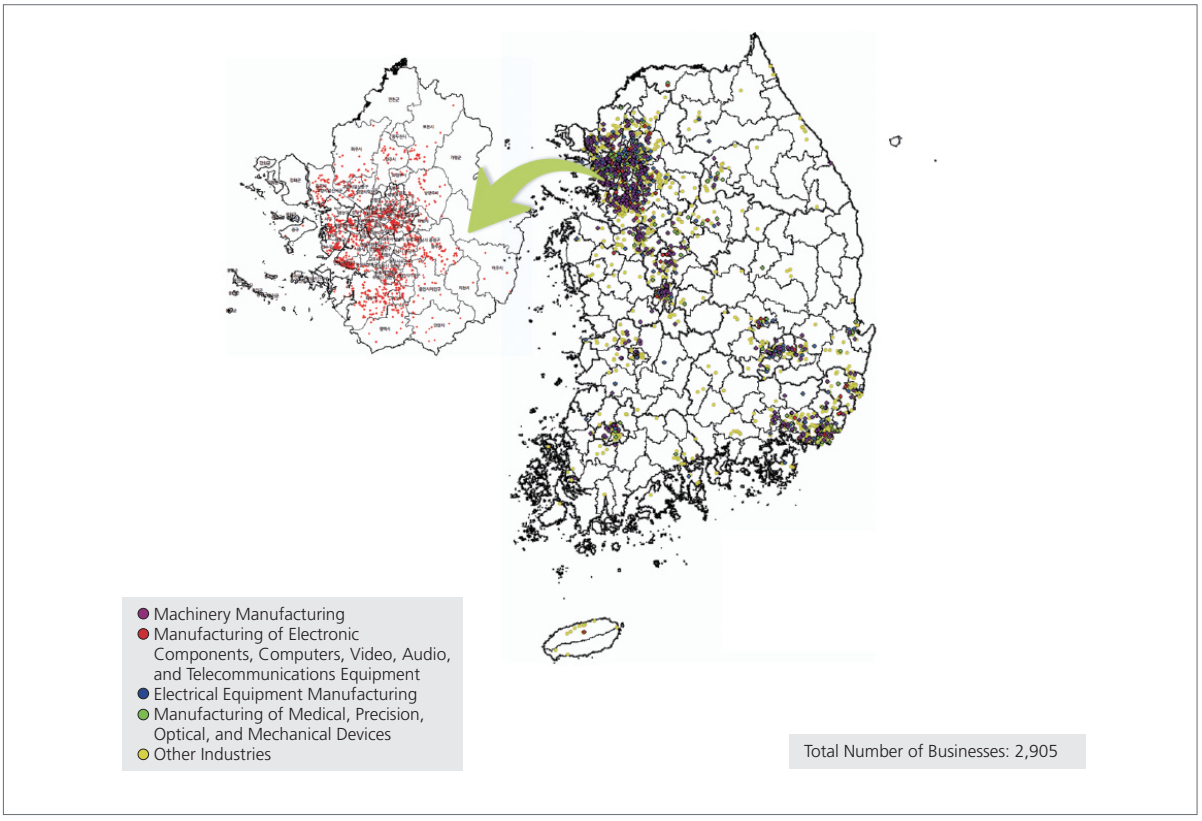
Technological innovations, including advancements in AI, big data, and other transformative technologies of the Fourth Industrial Revolution, are expected to drive significant changes in local industries, employment, and spatial structures. These innovations are creating new industries and facilitating a shift toward a hyperconnected society. Digital technologies and data analytics, such as AI and blockchain, are likely to converge

Figure 7. Change in real GDP per capita and growth rate



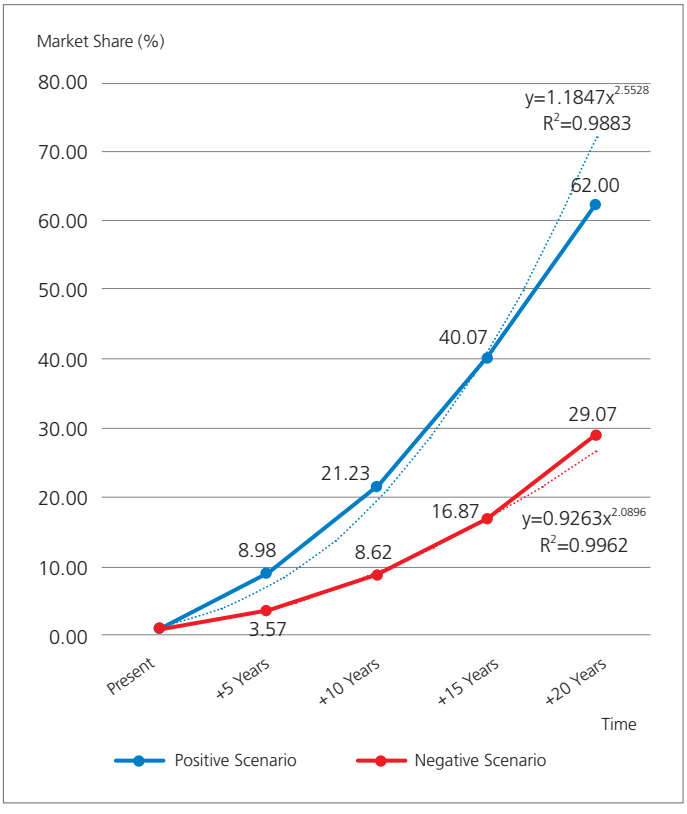
Source Bank of Korea & Statistics Korea (2024)

Figure 8. Distribution of tech manufacturing startups ('14 to '18)



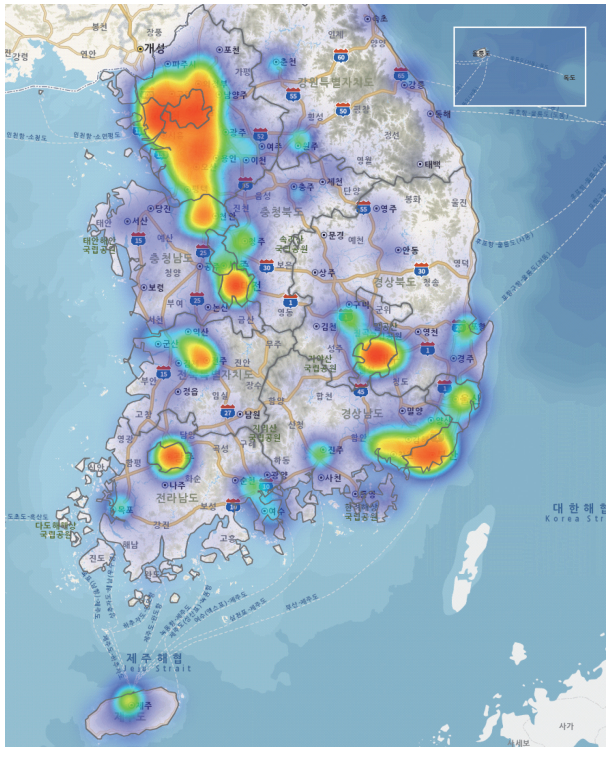
Source
Korea Research Institute for Human Settlements (2019)

Figure 9. Autonomous vehicle adoption scenario



Source Korea Research Institute for Human Settlements (2017)

Figure 10. Distribution of tech industries by city and province



Source Statistics Korea (2022)

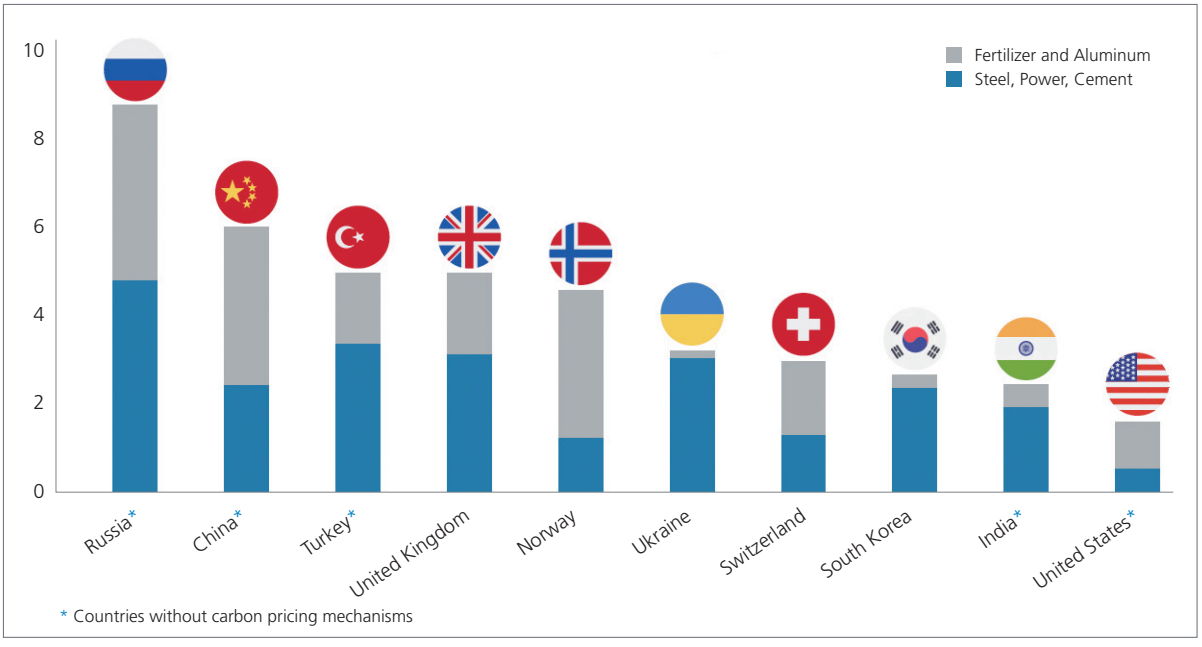
with economic and social systems, enabling smarter and more intelligent land management and living environments. Technological developments are expected to reshape geospatial structures by reducing time and space constraints on industrial location and spatial use. This will enhance convenience in daily life, including residential, transportation, and economic activities. Additionally, the rising demand for urban services is expected to reinforce the roles of major cities. At the same time, societal preferences for improved work-life balance, reduced working hours, and increased participation in leisure and cultural activities will expand behaviors associated with the sharing economy.

First, the national transportation and communication sectors will expand. The integration of technological innovations is expected to increase demand for precise, location-based spatial information, driven by the development of the land transportation industry and the creation of new industries and jobs, such as AI. The promotion of smart urban infrastructure that integrates and uses urban data via digital platforms will further amplify the growth of the transportation and logistics sectors. Second, land use management and services will experience significant improvements. The application of big data in transportation services will enhance policy responsiveness, while technologies such as autonomous vehicles, drones, and 3D printing will open new developmental opportunities in rural areas. Autonomous vehicles are expected to revolutionize transportation systems and bring transformative changes to spatial structures. The adoption of Mobility as a Service (MaaS) platforms, which integrate transportation modes such as autonomous vehicles, hydrogen-electric vehicles, and drones, will expand mobility solutions. The hyperconnectivity characteristic of the Fourth Industrial Revolution will mitigate spatial and temporal constraints, but its benefits are likely to be unevenly distributed. Technology companies are expected to concentrate in metropolitan areas, potentially leading to declines in traditional industrial zones, particularly in heavy chemical industrial cities, which could experience reduced economic activity and job losses. Figure 9, Figure 10

4) Climate Change and the 2050 Carbon-Neutral National Land

The global push toward carbon neutrality is accelerating the transition to a carbon-neutral society. Global warming significantly affects urban environments, exemplified by rising domestic temperatures and increased precipitation, highlighting the urgent need for global cooperation to address climate-related challenges. The intensification of climate change, primarily driven by greenhouse gas emissions, is projected to result in astronomical socio-economic costs, necessitating a robust interdisciplinary response from governments to meet the strengthening international norm of carbon neutrality. As public awareness of environmental values grows, shifts in land use and lifestyle are anticipated. Moreover, global ecological and environmental issues, such as fine dust and microplastics,

Figure 11. Scale of energy-intensive goods among EU exporters



Source
Deloitte (2021)

demand collective responses at national, regional, and international levels.

First, regionally customized environmental and ecological measures are becoming increasingly necessary, owing to evolving international norms. Following the declaration of 2050 carbon neutrality, greenhouse gas reduction targets (NDCs) have been established, aligning with global trends. However, achieving these targets could decrease industrial production, and in maximum reduction scenarios, disrupt new investments in core industries, presenting a significant concern. To mitigate these challenges, regional and industrial collaborations are essential to decarbonize existing industrial facilities and formulate detailed, actionable policy measures for decarbonization. Second, it is urgent to recalibrate national disaster prevention standards to address large-scale disasters linked to climate change. This involves identifying disaster-prone areas, analyzing vulnerabilities, and implementing region-specific disaster prevention strategies. Figure 11, Figure 12

3. Public Perceptions on Drivers of National Territory Change

A public survey was conducted to prioritize the factors expected to most significantly affect national territory change among 20 identified drivers. The results showed that the top three drivers influencing the country were capital area concentration (40.1%), regional decline (17.8%), and continued ultra-low birthrate (13.5%), followed by the intensification of climate and environmental change (12.6%). To create future scenarios, experts analyzed the 20 identified drivers of land change and refined them into five core drivers that cover various aspects of land dynamics: residence (the concentration or dispersion of residential patterns), jobs (the creation of jobs and their spatial distribution), mobility (changes in travel demand, including variations in travel speed and distance), safety (the extent of adaptation to climate change and the overall stability of the land), and land technological innovation (the degree of success in technological innovation affecting land use and management). Based on these core drivers, experts developed five combined scenarios (10 in total) to forecast diverse potential futures for the national territory. Figure 13

4. Present a Comprehensive Scenario

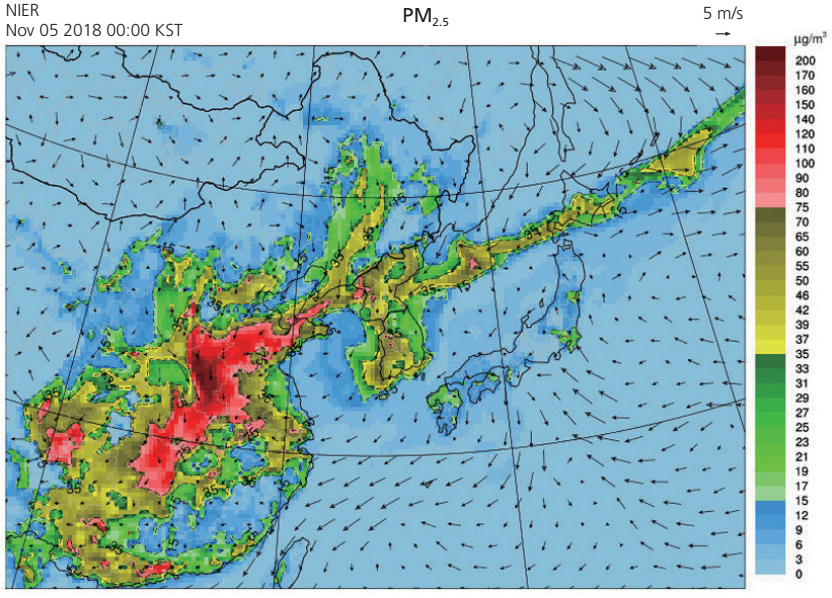
The following three comprehensive scenarios, each with two axes, were derived for intuitive understanding:

1) Criteria for Deriving Comprehensive Scenarios

① National Territory Risk Axis

The degree of uncertainty and risk that the national territory faces from various drivers and their interactions that we cannot predict, such as technological change, climate change, and so on.

Figure 12. Spread of fine dust in East Asia



Source
National Institute of Environmental Research (2018)

② National Adaptive Capacity of National Territory Axis

This refers to the resilience of our national territory to environmental changes and its ability to respond to national territorial policies. It includes the capacity to manage the pressures of national territory change through the current land and urban management system or by transitioning to a new land management framework.

2) Derive a Comprehensive Scenario

The following three scenarios are based on "National Territory Risk" and "National Adaptive Capacity of National Territory":

① Business as Usual Scenario: High-Risk Disproportionate National Territory

If the current megatrends persist, future land use will be marked by ongoing ultra-aging and low birthrates, economic decline, and climate crises. Digital transformation and heightened inter-regional mobility will continue to favor capital areas, resulting in increasingly severe land risks and worsened land imbalances.

② Collapse Scenario: Ultra-Hazardous Fragmented National Territory

In the pessimistic scenario, economic and environmental risks are extremely high, owing to an economic slowdown and failed policy responses to the worsening climate crisis. Mobility increases with the expansion of high-speed transportation infrastructure; however, the demand for mobility is limited because innovative jobs and residents are concentrated in capital areas. This scenario leads to regional decline and the visible disappearance of non-metropolitan areas.

③ Continued Growth Scenario: Secure Balanced National Territory

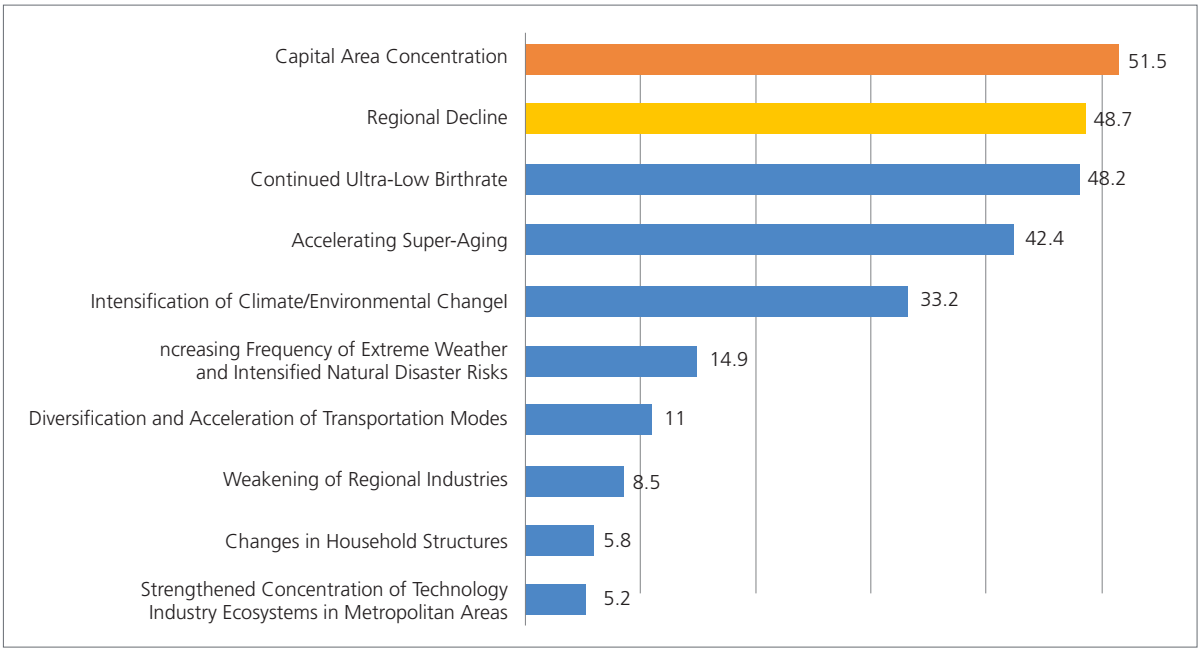
In the optimistic scenario, public awareness of external shocks, such as demographic changes, low growth, and climate crises, increases, thereby strengthening national territorial policy response capabilities. This scenario envisions improved management of homeland risks and reduced disparities through stronger connections between regional bases.

3) Scenario-Based Strategies

As of 2024, national territory policy has reached a critical transition point. In response to population decline, low economic growth, climate crises, and technological transformation, several key shifts in policy focus are necessary.

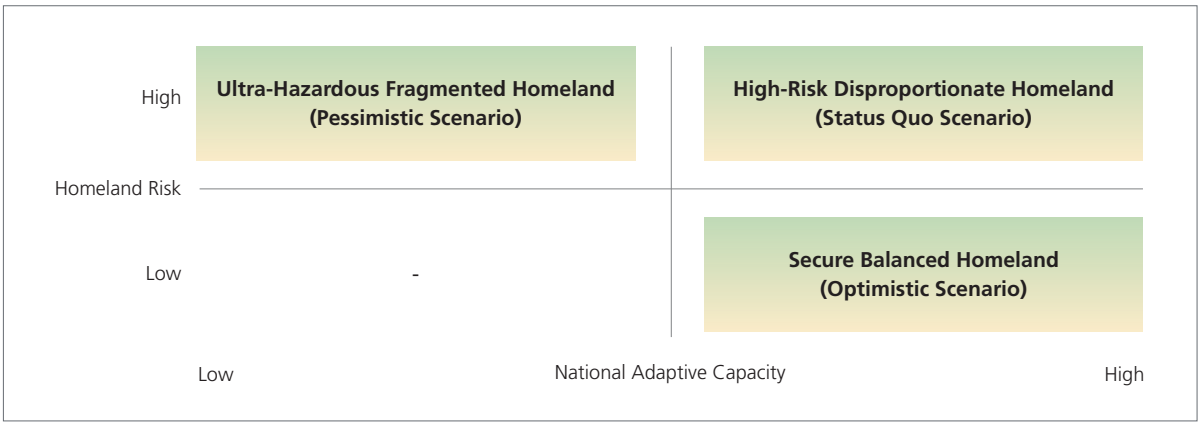
First, policies should shift from focusing on development and expansion to efficient national territory management and balanced strategies that prepare for regional extinction, technological innovation, and climate crises. Second, land transportation policies need to incorporate advanced technologies, such as AI and digitalization, to lead various transportation services and related industries. Third, eco-friendly land policies aligned with international norms of carbon neutrality should address the growing climate crisis and adapt to shifting public values, emphasizing quality of life, leisure, work-

Figure 13. Ranking of change drivers that will result in the greatest land change (1+2+3 Rank, %)



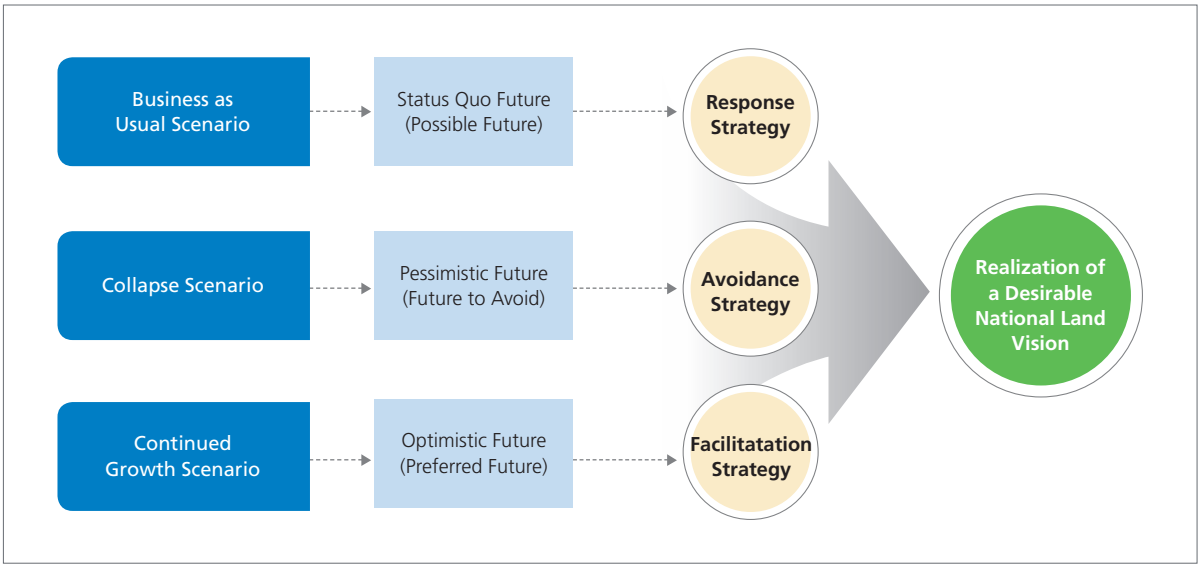
Source
Korea Research Institute for Human Settlements (2024)

Figure 14. Comprehensive Scenarios



Source
Authors

Figure 15. Scenario-based strategy



Source
Kim (2020)

Table 1. Key policy projects by strategy (example)

Item	Key policy projects (example)
Facilitation strategies	• Foster a multi-layered spatial structure and growth hubs by regional hierarchy (concentrated decentralized balance) • Promote population revitalization • Strengthen the expansion of innovation-based jobs • Increase flexible housing supply • Enhance climate change mitigation/adaptation measures • Support innovation in transportation modes • Advance technological innovation to promote a smart society
Avoidance strategies	• Strengthen local living services and institutional improvements to respond to aging and multicultural societies • Enhance urban regeneration • Timely upgrade of aging infrastructure • Reinforce the regeneration and maintenance of idle facilities, including the maintenance of vacant housing • Strategically redevelop first-generation new towns • Rational operation of capital area regulations
Response strategies	• Foster ultra-metropolitan areas and expanding metropolitan transit networks • Expand green infrastructure and ecosystem services • Reduce regional disparities in living infrastructure

Source
Authors

life balance, and safety.

To maintain the sustainability of the socioeconomic system amid megatrend changes, transportation policies must innovate to address these emerging challenges. This study identifies key policy issues from the perspective of scenario-based response strategies to guide future actions. **Figure 14, Figure 15**

First, the facilitation strategy includes policy tasks that aim to induce a desirable and optimistic future. This strategy focuses on regional innovation, population revitalization, and developing alternative measures to address climate change, while maintaining a concentrated decentralized balance. Second, the avoidance strategy is designed to prevent and prepare for a pessimistic future. It includes policies that address the challenges of an aging and increasingly multicultural society, aging infrastructure, vacant housing, and urban regeneration. Third, the response strategy targets a moderate status quo scenario by implementing policies that improve current conditions. These policies support ultra-metropolitan areas, decrease regional disparities in living conditions, and expand green infrastructure. These strategies are complementary and should be implemented systematically. Policymakers must approach them from both short-term and mid- to long-term perspectives, prioritizing actions based on their urgency and importance. **Table 1**

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* This article is an overview of "Future National Territory Issues and Strategic Responses Toward 2050" by Jeong Wooseong, Chang Yohan, Jo Manseok, and Kang Minseok. 2024. Sejong: Korea Research Institute for Human Settlements.

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02 Strategies for Establishing Carbon-Neutral Cities in Response to the Climate Crisis

Eun Joo Yoon

1. Climate Crisis and Carbon-Neutral Cities

Achieving carbon neutrality by 2050 is a prerequisite for limiting global warming to 1.5°C, which is critical for global sustainability (IPCC, 2018). Since declaring a commitment to "2050 Carbon Neutrality" in 2020, South Korea has also established necessary laws, organizations, and reduction plans aimed at 2030 and 2050. However, now is the time to discuss how to implement carbon neutrality at the regional level. In this context, "carbon-neutral cities" could serve as platforms for comprehensively and intensively implementing various reduction strategies and measures developed thus far at the regional level (Ahn, Y. & Yoon, E., 2021). Nevertheless, conceptual frameworks, foundational data, and planning methodologies at the regional level, which are needed to establish carbon-neutral cities, are still insufficient. In particular, spatial planning is useful for enhancing acceptability and efficacy by appropriately reflecting the context of existing cities, but related studies and successful cases are scarce. Therefore, this study aims to propose the concept and direction for establishing carbon-neutral cities as well as the process and methodologies (hereinafter referred to as planning models) for concretizing them into spatial plans.

2. Concept and Direction of Carbon-Neutral Cities

To establish the concept of Korean carbon-neutral cities that reflect South Korea's distinctive characteristics, this study examined the meanings of "Korean" and "carbon-neutral cities" individually. Considering the paradigm shifts in eco-friendly cities and the recent international examples of planning aimed at carbon neutrality, "carbon-neutral cities" shared a few common attributes in meaning as follows. First, these cities set the ambitious and quantifiable goal of "net-zero emissions," which is different from low-carbon cities aimed at "reduction" itself. Second, they intensively implemented various reduction strategies and measures around certain spaces to achieve carbon neutrality. Third, despite the same goal of carbon neutrality, the paths to reach the goal were differentiated depending on the regional conditions. Fourth, the feasibility of implementation was enhanced by concretizing the spatial plans within the possible range (Yoon, E. et al., 2023, 53-54).

Next, to derive the meaning of "Korean" based on the regional strengths, weaknesses, and aims for establishing carbon-neutral cities, surveys were conducted with local experts and citizens. The strengths identified included abundant forests and well-developed urban infrastructure, while weaknesses included poor financial conditions of local governments as well as lack of workforce. However, large urban areas such as the capital region had disadvantages in urban spatial structure compared to areas such as Gangwon-do and Jeolla-do, but they had a more abundant human resource pool (Yoon, E. et al., 2023, 37). Next, important aims for carbon-neutral cities included respect for regional identity, "eco-friendliness" as a value that encompasses reduction, and "technological and industrial compatibility" to align with existing industries and technologies in the region (Yoon, E. et al., 2023, 39). In sum, this study defined the concept of a carbon-neutral city as "a city that achieves carbon neutrality, and further sustainability, by implementing various reduction measures in a spatial framework in light of regional conditions" (Yoon, E. et al., 2023, 55).

3. Planning Model for Carbon-Neutral Cities

This study proposed establishing an inventory of reduction measures and regional conditions as foundational data for carbon-neutral city planning. The basic unit for reduction amount had already been provided for each reduction measure (Korea Environment Corporation 2022), but this study created a "Reduction Measures Inventory" that supplemented the

indicators to assess each local government's current application status (experience) and feasibility and the relevance with other reduction measures (Yoon, E. et al., 2023, 77). Furthermore, a "Regional Conditions Inventory" was also established by assessing the current application status and feasibility of each reduction measure across 229 local governments. Local governments can use these inventories to identify the current application status and feasibility of each reduction measure as well as their comparative advantages relative to other local governments (Yoon, E. et al., 2023, 78-88).

Next, this study proposed methodologies for each step of the planning model divided as follows: (1) analyzing conditions and selecting key reduction measures, (2) setting goals for each reduction measure, (3) exploring and zoning priority spaces for each reduction measure, and (4) developing facility-level plans.

1) Analyzing conditions and selecting key reduction measures

The Regional Conditions Inventory introduced above can be used to identify the priorities for reduction strategies and measures. If a region has both higher application experience and feasibility for a certain measure compared to other regions, this measure is given the highest priority. If only one of the two is higher, this measure can be implemented in association with policy or technical support. Of course, for actual decision-making, considering the humanities and social, economic, and policy-specific factors for qualitative analysis, in addition to quantitative analysis, is necessary.

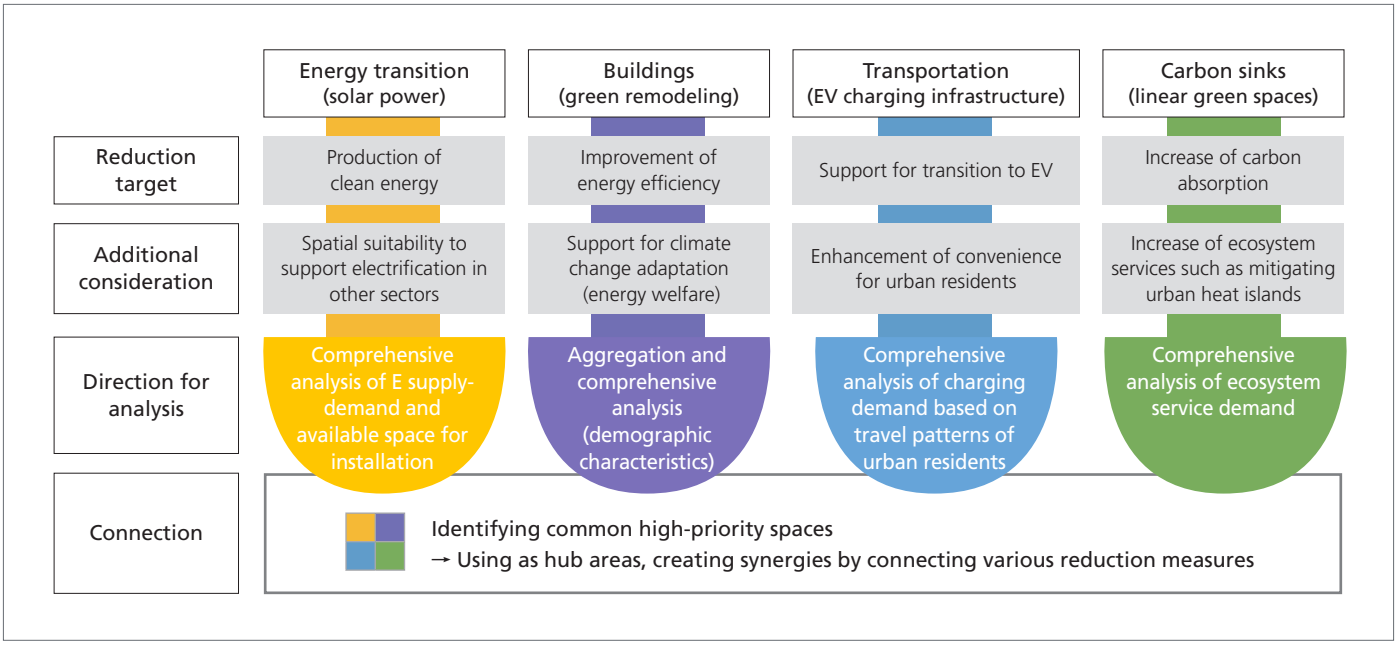
2) Setting goals for each reduction measure

Reduction goals for individual reduction measures can be established in a top-down manner by considering the national targets and the local government's relative strengths/weaknesses (see Regional Conditions Inventory). However, enhancing the plan's effectiveness by selecting the land and facilities where reduction measures can be applied in the spatial planning steps (see Steps 3) and 4) below) and adjusting reduction goals from the bottom up accordingly is necessary.

3) Exploring and zoning priority spaces for each reduction measure

The efficiency of carbon-neutral initiatives can be improved by assessing spaces where reduction measures are expected to be most effective (hereinafter referred to as priority spaces) and applying them to the plan. In addition to reduction effects, factors such as demand-supply balance of energy, public convenience, and ecosystem services can be considered to increase citizens' acceptance for reduction measures and even encourage some co-benefits. This study suggested the methods for assessing priority spaces for reduction measures as shown in <Figure 1>, such as solar power, green remodeling, EV charging infrastructure, and green spaces. If multiple high-priority spaces

Figure 1. Exploring priority spaces for each reduction measure



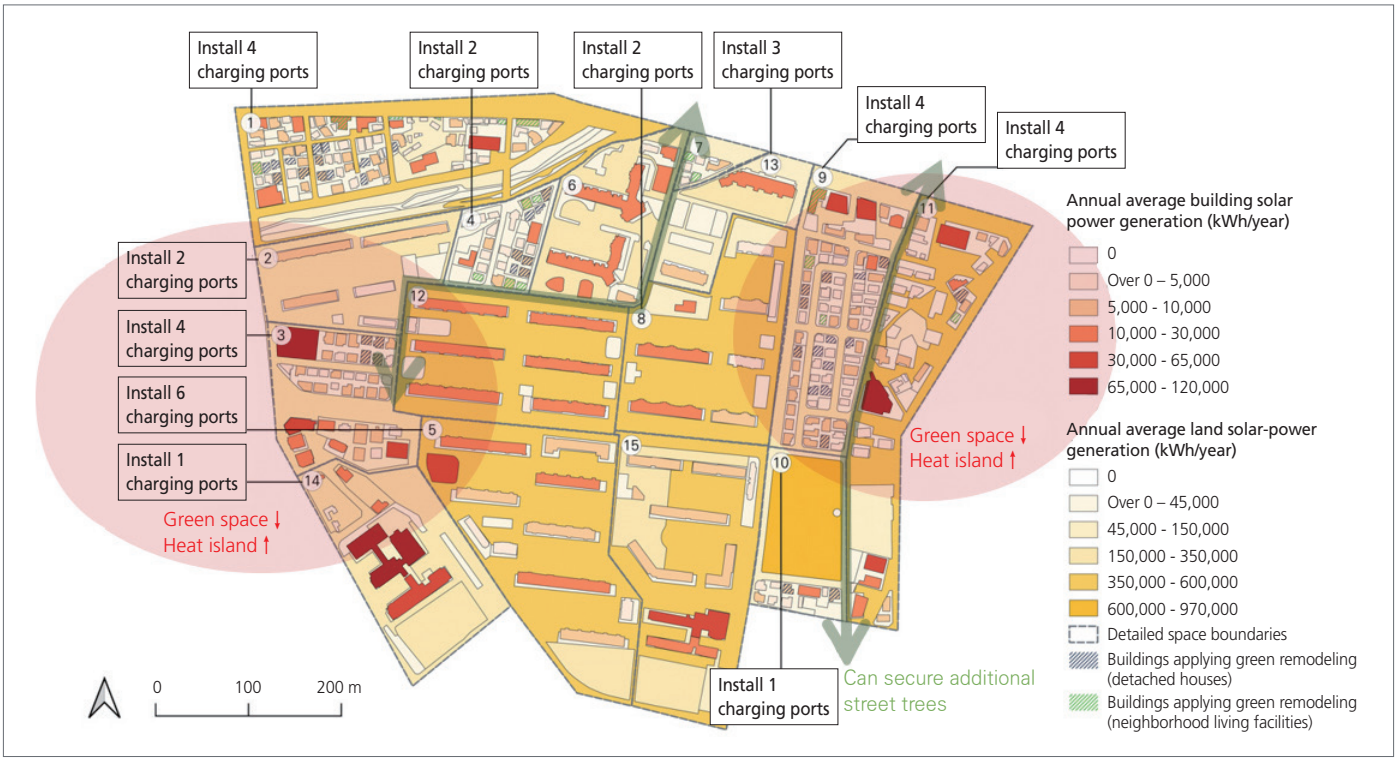
Source Yoon, E. et al. (2023, 106)

overlap for different reduction measures, these spaces should be designated as "Carbon-Neutral Priority Zones (tentative name)" to implement relevant initiatives in an integrated manner. Figure 1

4) Developing facility-level plans

Once a Carbon-Neutral Priority Zone (tentative name) is designated, a detailed spatial plan is established by determining whether reduction measures should be applied to specific lands and facilities within that zone. In this step, information obtained from on-site investigations and stakeholder interviews, in addition to the spatial data compiled during the priority space assessment step, can be considered comprehensively. For example, in the case of green remodeling, aspects such as building use, structural suitability, building age, energy consumption, and reduction effectiveness are identified through spatial data, while property ownership, cost-sharing potential, and ease of relocation are identified through on-site investigations and interviews. <Figure 2> and <Table 1> below show the results of the pilot arrangement of reduction measures and their calculated effects for the area surrounding Gosaek Station in Suseong-gu, Daegu. First, the required number of charging ports for each block was calculated based on charging demand in light of travel patterns as well as the associated increase in power consumption. Second, buildings with low energy efficiency and over 20–30 years old were selected for green remodeling, and the expected energy savings were calculated accordingly. Third, for lands and facilities not restricted by legal standards for solar installation, potential power generation was estimated by considering the number and area ratio of solar panels that can be installed. Moreover, the extent to which solar power supply could meet the demand (considering changes due to the adoption of EV charging ports and green remodeling) within the zone was assessed. Results showed that solar power could supply 48% of power demand in the entire zone, while at the block level, energy independence was higher in the area with low-rise detached houses (Block 1) than in multi-family housing areas (Blocks 2, 5, 6, 8, 12, and 15, Yoon. E., 2024a, 34). Fourth, for roads without street trees and with severe heat islands (indicated by green arrows), the reduction amount was calculated assuming that street trees would be planted on one side of these roads. Conversely, multi-family housing areas with small gardens or detached housing areas connected to river spaces showed low heat island levels. Figure 2, Table 1

Figure 2. Exploring priority spaces for each reduction measure



Source Yoon, E. (2024a, 33)

4. Conclusion and Future Tasks

The concept and planning model proposed in this study can contribute to establishing more distinctive and sustainable spaces with carbon neutrality as an opportunity beyond the standardized logic that only emphasizes reduction. However, further research is needed in the following areas to expedite the realization of carbon-neutral cities. First, research that internalizes the planning model into the current urban planning systems is necessary. This can make it mandatory to establish the goals of "carbon neutrality" and evidence-based planning for various plans and guidelines, aligning the foundational data and evaluation methodologies presented in the planning model to such guidelines. Second, research supporting and ensuring national carbon-neutrality goals through regional carbon trading, even when the regional reduction goals are adjusted depending on the circumstances, must be conducted. Third, research must integrate carbon neutrality with climate adaptation with a focus on spaces. Since climate change impacts still occur owing to greenhouse gases that are already emitted even if carbon neutrality is achieved, adaptation efforts from the perspective of sustainability must be strengthened.

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Table 1. Reduction effects by reduction measure

Reduction measure	Level of application	Reduction amount (tCO_2eq)
Solar power	• Annual power generation 12,377.8 MWh	5,917.8
Green remodeling	• Reduction in power 1,241.0 MWh • Reduction in gas 2,230.3 MWh	999.9
EV charging stations	• Assumes operation of 238 electric vehicles enabled by charging stations	230.9
Green space	• Planting of 373 street trees	3.1
Total		7,151.7

Source
Compiled by the author based on Yoon, E. et al. (2024b, 205-206)

* This article is an overview of "Strategies for Establishing Carbon-Neutral Cities in Response to the Climate Crisis" by Yoon, E.J. Proceedings of KRIHS 46th anniversary seminar. 2024. Sejong: Korea Research Institute for Human Settlements.

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03 Next-Generation Mobility for Sustainable Regional Development

Backjin Lee

1. An Overview of Next-Generation Mobility

Mobility refers to the ability of people or goods to move from one location to another. Recently, next-generation mobility has been on the rise with the incorporation of information and communication technologies (ICT), including artificial intelligence (AI), 5th-generation mobile networks (5G), and the Internet of Things (IoT). Since next-generation mobility may provide efficient, safe, and environment-friendly mobility services, it is being promoted as a key policy in major developed countries, and numerous companies are actively developing related technologies.

■ **New means of transportation in the next-generation mobility include connected vehicles (CVs), autonomous vehicles (AVs), eco-friendly vehicles (EVs), urban air mobility (UAMs), and personal mobility (PMs).**

CVs can improve safety through real-time two-way communication between vehicles and road facilities. AVs may reduce travel stress and heighten safety for drivers through automated driving, while autonomous buses are expected to improve the efficiency of public transportation operations. UAMs may dramatically reduce travel time by extending traditional land-based mobility to the air, avoiding road congestion. PMs are a first- and last-mile transportation method, enabling fast and convenient travel over short distances. EVs, such as electric and hydrogen vehicles, may reduce the use of fossil fuels and greenhouse gas emissions associated with traveling.

■ **The emergence of new means of transportation demands new transportation facilities.**

For CVs and AVs to operate safely on the road, the interconnection of vehicles and roads is vital, and the digitalization of roads, or Digital Road, is necessary. Likewise, for UAMs to operate within a metropolitan center, an urban air terminal (Vertiport) must be installed. Moreover, mobility hub facilities, which bring together various means of transportation such as AVs, UAMs, and PMs at transportation nodal points, are needed to improve transfer convenience.

■ **Next-generation mobility is overhauling the ways in which existing transportation services are delivered and operated.**

Recent examples include Shared Mobility and Mobility-as-a-Service (MaaS), which are based on a digital platform that integrates various transportation means to provide services. Furthermore, real-time traffic operations that use AI and big data are expanding to monitor traffic volume using travel data on vehicles and people collected in real time and optimize traffic signal operations by predicting road situations in real time. Table 1

2. The Importance of Next-Generation Mobility for Sustainable Regional Development

■ **Next-generation mobility and a paradigm shift in transportation**

Next-generation mobility is bringing about a shift in the paradigm of transportation. Vehicles are shared instead of owned, and provider-oriented service delivery enables users to make an active choice in service. For instance, diverse mobility options are offered by bringing separate transportation means, such as autonomous buses, PMs, and UAMs, to a digital platform; this allows consumers to select the means that suit them best. Furthermore, from the supply of only physical facilities, such as existing roads, next-generation mobility requires a convergence in the supply of physical and digital (IT) facilities. In other words, existing infrastructures should be able to support new means of transportation, such as AVs, through digital transformations. The emergence of UAMs expands the

current two-dimensional travel space of roads and railways to three dimensions by including aerial space. By automating transportation of people and goods, autonomous driving lessens the temporal and spatial constraints of service delivery. Travel time was previously a negative factor that needed to be reduced as much as possible; however, with the emergence of AVs, it has become a positive factor as people can engage in various activities (e.g., work and entertainment) instead of driving.

■ The importance of next-generation mobility for sustainable regional development

Provincial regions currently face a range of social and economic challenges. Rural areas suffer from a declining economic vitality due to a decreasing and aging population, which brings about labor shortage. Disparities in social infrastructures, including employment opportunities, education environment, IT, and transportation services, between metropolitan and rural areas are a major reason for

Table 1. UAM operation lines within a region (example)

Category		Explanation	
New means of transportation	Connected Car	Vehicles equipped with communication modules that enable data sharing through two-way communication between infrastructure facilities and smartphones.	
	Autonomous vehicle	Vehicles that can perceive, judge, and control without driver intervention, traveling safely from one location to another.	
	Eco-friendly vehicle	Vehicles powered by alternative energy sources such as electricity, hybrid source, and hydrogen fuel cells, minimizing fossil fuel use and greenhouse gas emissions.	
	UAM	Using eVTOL, a new concept of aircraft that combines electric power and rotary-wing aircraft, traveling three-dimensionally within city centers or from once city center to another.	
	PM	A compact mobility device for one person, such as electric bicycles and electric scooters, to travel short distances quickly and conveniently.	
New transportation facilities	Digital Road	High-tech road facilities where roads and vehicles are connected in real-time via communication to support collaborative driving and autonomous driving, improving traffic safety.	
	Vertiport	Urban air transport terminals for the take-off, landing, boarding, transfer, charging, and maintenance of UAM aircraft.	
	Mobility Hub	A transportation nodule where various means of transportation (e.g., public transportation, PMs, and AVs) assemble, allowing users to travel conveniently.	
New transportation services	Shared Mobility	A hybrid nature of transportation that acts as both personal and public means of transportation through the sharing of vehicles, PMs, and bicycles.	
	MaaS	The concept of providing various transportation services through a single integrated platform. Users can book and pay for multiple means of transportation at once via smartphones.	
	Traffic Management using big data & AI	Manages traffic by monitoring and predicting traffic volume in real time and optimizing traffic signals by using vehicles' and people's travel data collected in real time.	

the continued population migration to metropolitan areas, worsening the vicious cycle. Transportation is less accessible in rural areas, which makes them less attractive to companies looking for a location. While these areas have a high demand for public transportation, healthcare, and welfare services, they find it difficult to even maintain the current level of services. Hence, sustainable regional development is an important agenda to address such issues.

Next-generation mobility may be key to sustainable regional development. For example, AVs or UAMs may dramatically improve local transportation mobility, with AVs making it possible for people to travel longer distances by easing the drivers' burden and reducing travel time through platoon driving system. Additionally, UAMs may not only significantly lessen travel time between regions but also raise the accessibility of remote areas and islands. Autonomous buses or logistics transportation using autonomous driving (e.g., drones) may provide effective transportation services to rural areas at a low cost. Although next-generation mobility cannot solve all regional problems, it may be used as a driving force behind new regional development through its effective introduction.

3. Next-Generation Mobility for Sustainable Regional Development

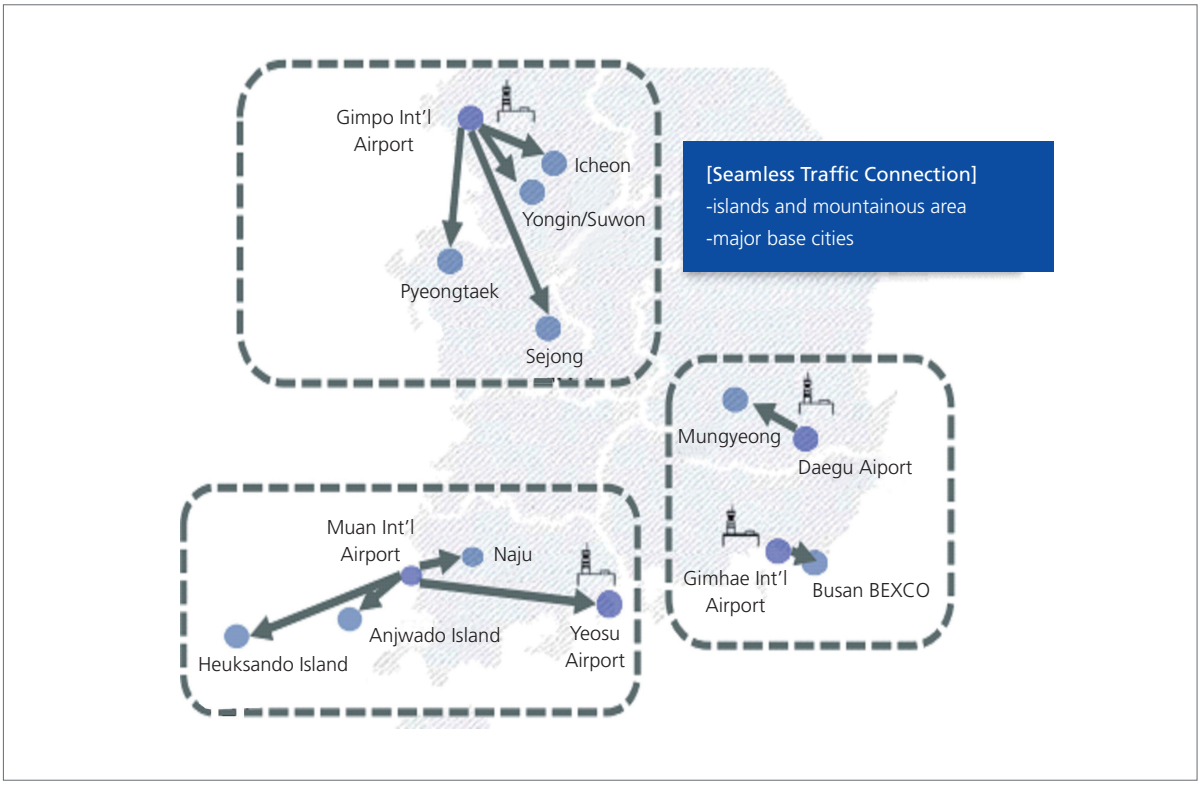
■ Improving wide-range accessibility of regions

Improving wide-range access to and from regions is an important factor in strengthening their competitiveness. According to Chang et al. (2017), transportation convenience and a decrease in logistics costs are the factors that companies consider the most when selecting a location. Moreover, remote regions, such as islands and mountainous areas, should improve their accessibility to large cities with high tourism demand to attract more visitors.

■ Next-generation mobility: UAMs

The South Korean government is promoting policies related to the preparation and service proliferation of UAM commercialization and is building a detailed roadmap (MOLIT, 2024). In particular, taking the aircraft development situation into consideration, it plans to promote three leading business models in 2026: a tourism type for revitalizing the tourism industry; a public type for emergency rescues, security and searches, and firefighting; and a transportation type that integrates with existing transportation infrastructures, including

Figure 1. UAM operation lines within a region (example)



Source
LX (2024)

airports and railway stations. UAMs can greatly improve accessibility to metropolitan areas from regions, from airports to city centers, remote areas to major cities, and cities to cities, not only raising the competitiveness of regional locations but also ensuring basic livelihoods and attracting more tourists. In the future, preparing plans to introduce various forms of UAMs that take into account regional characteristics will be necessary.

■ Next-generation mobility: Cooperative Autonomous Roadways (CARs)

Cooperative Autonomous Roadways (CARs) are roads (or lanes) specifically for autonomous vehicles. On such roads, AVs, autonomous buses, and other means of next-generation mobility may be operated without the interference of conventional vehicles, and they will enable the safe and comfortable travel between regions through platoon driving system and total traffic control. The CAVNUE Project that has been underway in Michigan, USA, since 2020 is a prime example of CARs. These are yet to be implemented in South Korea, and CARs demonstration projects must be actively pursued to improve the connectivity between base cities and neighboring cities within regional zones. **Figure 1, Figure 2**

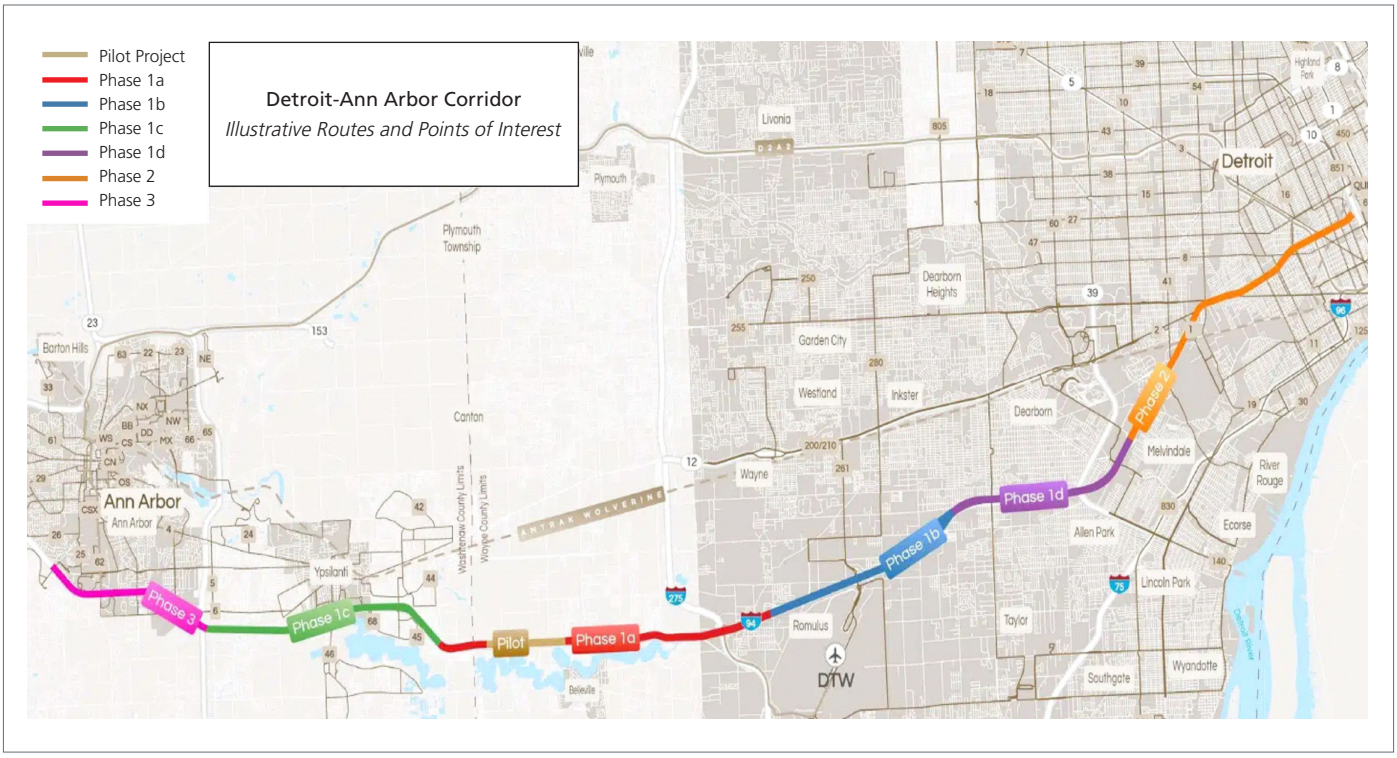
■ Improving regions' public transportation services

Regional public transportation services are vital factors for securing the residents' mobility rights and regional development. Meanwhile, compensation for operational losses to maintain the main bus services in a region continues to grow. Such subsidies burden the region's finances and may act as a limiting factor in the investment in other sectors for regional development. Despite deficit financing for bus operations, the number of running buses and operating routes are decreasing owing to declining number of users. Moreover, the quality of services is deteriorating, with no services offered late at night or during certain times during the day. Furthermore, regions are finding it difficult to secure bus drivers, and an aging driver population raises concerns about safety.

■ Next-generation mobility: Autonomous bus

The cities of Seoul and Sejong are currently conducting demonstration projects for autonomous buses, and their formal introduction is expected to occur soon, even if not in the form of fully autonomous driving. Labor costs can be saved with the operation of autonomous buses as these either do not require a driver or need only an assistant driver; fuel efficiency also increases as most of these buses run on environment-

Figure 2. UAM operation lines within a region (example)



Source CAVNUE (2024)

friendly energy sources. Additionally, the number of such buses and their routes may be expanded, offering stable services at particular times and in remote locations. Autonomous driving technology can also mitigate the risk of accidents. Figure 3

■ Next-generation mobility: Expansion of Demand Responsive Transit (DRT)

Unlike conventional fixed-route buses, Demand Responsive Transit (DRT) is a method of operating bus routes flexibly based on a digital platform that reflects the real-time demand of individual users. As of 2023, over 200 buses in 20 localities are currently providing this service. A more effective DRT operation will be possible in the future when autonomous buses and shuttles are included in the system.

■ Next-generation mobility: Mobility Hub and MaaS

Built upon shared mobility, a mobility hub is a place that provides the convenience of public transportation transfers and short-distance travel and may also serve as a base for a living sphere that offers various daily life conveniences as needed by a region. For instance, it can provide first/last mile services through PMs and other shared mobility means set up at major traffic nodal points (e.g., airports, terminals, and stations) within a region, improving connectivity to public transportation and accessibility to surrounding commercial areas. Furthermore, a region's accessibility may be improved through MaaS, which offers various travel services via a single, integrated platform from the beginning to the end of travel (within a region or between regions). Figure 4, Figure 5

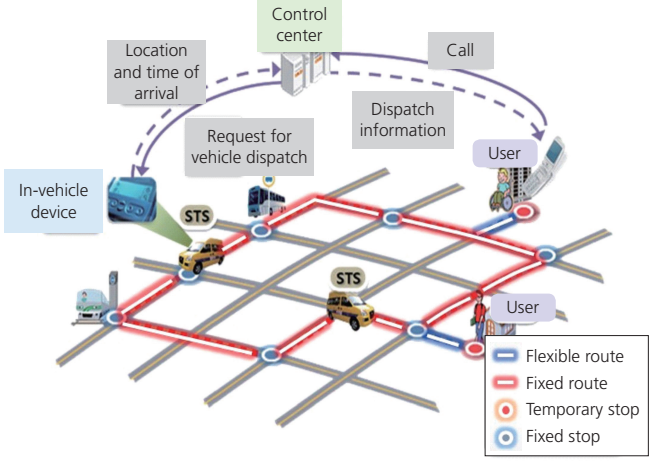
Figure 3. Example of autonomous bus (Seoul)

World's first late-night autonomous bus (Dec. 2023)

Early morning autonomous bus (planned for Oct. 2024)

Source
Seoul Metropolitan Government (2024)

Figure 4. DRT operation (example)



Source Lee (2020)

Figure 5. Mobility Hub (example)

Source Park (2018)

■ **Reconstruction of urban space**

The number of vacant houses and idle facilities are increasing in regional cities owing to a declining and aging population, and hence, new utilization measures for such spaces are needed. Additionally, new growth engines are needed to revitalize the residents' local communities and urban centers that have deteriorated owing to worsening local economy. The gap in advanced transportation services (e.g., with the provision of real-time information) between metropolitan cities and regional cities is widening owing to the lack of IT infrastructure in the latter.

■ **Next-generation mobility: Mobility-specialized city**

Next-generation mobility could be an opportunity to reconstruct the space of regional cities. For instance, through the introduction of AVs, the number of traffic lanes or parking spaces may be reduced, possibly making more room for sidewalks, PM roads, gardens, and cafes. Idle facilities in a region may turn into cities' common distribution centers for automated transport. Moreover, idle spaces may become recharging stations for EVs, parking and transfer facilities for PMs, and Vertiports for UAMs. Furthermore, by bringing UAMs, AVs, and PMs together in single space, a mobility hub may be established, optimizing travel within and between regions; such a hub will attract companies, revitalizing local commercial areas and fostering local industries.

4. Conclusion

The emergence of next-generation mobility is a critical opportunity to achieve sustainable regional development. First, next-generation mobility may dramatically improve a region's wide-area accessibility. Second, it can better the effectiveness of a region's public transportation services that currently continue to worsen by providing universal transportation services. Last, the introduction of next-generation mobility may be an opportunity to innovate a city by finding new uses for a region's idle spaces, encouraging economic growth and improving people's quality of life.

Next-generation mobility, however, is a new technology that inevitably conflicts with the existing transportation system. For instance, a conflict occurs in the operation of autonomous vehicles and regular vehicles. Furthermore, the issue of low-investment utility may arise owing to a discrepancy in the initial supply and demand of next-generation mobility as it requires a large initial investment for installing necessary IT facilities. Protection of personal information on digital platforms is another problem to address.

At present, traditional means of transportation and next-generation mobility are converging, and this situation is expected to continue for some time. Therefore, at this time, the public and private sectors should cooperate on developing relevant technologies, efficiently easing regulations, and actively proposing consistent investment policies regarding the various problems that may arise when introducing next-generation mobility.

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KRIHS Hosts a Commemorative Seminar for its 46th Anniversary

Date: October 17, 2024 (Thursday)
Location: KRIHS Auditorium

The Korea Research Institute for Human Settlements (KRIHS) celebrated its 46th anniversary on October 17 with a seminar titled "The Era of Great Transformation: Crisis Response and Strategies for Future and Land Development." The event, held at 2:00 p.m. in the KRIHS Auditorium, provided an opportunity to address the challenges facing Korea's land development in an era of profound transformation and to explore crisis response strategies.

Dr. Gyo-Eon Shim, President of KRIHS, opened the seminar, setting the stage for three insightful presentations on Korea's future land development.

Dr. Wooseong Jeong, a research fellow at KRIHS, delivered the first presentation, Megatrends and Future Land Outlook. His talk examined the key trends and issues in the land and transportation sectors, using scenario analysis to outline strategic directions for Korea's land development.

Dr. Eun Joo Yoon, an associate research fellow at KRIHS, followed with a presentation titled "Strategies for Creating a Carbon-Neutral Urban Space to Respond to the Climate Crisis." Yoon introduced the concept of a carbon-neutral Korean city, presenting foundational data, planning models, and real-world examples from local governments. She also recommended legal and institutional improvements to support these goals.

Dr. Lee Baekjin, a senior research fellow at KRIHS, concluded the presentations with "Sustainable Regional Development Strategy Based on Next-Generation Mobility." Lee discussed next-generation mobility concepts, proposed an outlook for this market in Korea, and offered strategies for sustainable regional development rooted in next-generation mobility.

During the general discussion, which was led by Dr. Soon-ja Lee, Director of the National Territorial and Regional Research Division at KRIHS, the panel shared insights and ideas on the future of Korea's land strategy and crisis response. The esteemed panelists included Researcher Seong-won Park (National Assembly Futures Institute), Professors Tae-jin Song (Chungbuk National University), Dong-keun Lee (Seoul National University), and Chang-gyu Choi (Hanyang University), Director Eui-sik Yoon (Ministry of Land, Infrastructure, and Transport), and Researcher Kyung-jun Ha (Busan Development Institute).

Dr. Gyo-Eon Shim closed the seminar by declaring his commitment to guiding Korea toward a resilient and sustainable future, stating, "We will continue our efforts to address Korea's challenges and devise strategies for a bright and prosperous future."

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KRIHS

KRIHS (Korea Research Institute for Human Settlements) was established in 1978 in order to contribute to the balanced development of national territory and the improvement of the quality of life of people by conducting comprehensive policy-oriented research in the efficient use, development, and conservation of territorial resources.

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