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Policy Case Studies

Bridging Digital Horizons: A Comparative Nexus of Government Policies and Cooperative Paradigms in South Korea and Southeast Asia's Smart Innovation Landscape

| 2025 KRI Discussion Paper No.2 |

Comparative Policy Case Studies

**Bridging Digital Horizons:
A Comparative Nexus of Government
Policies and Cooperative Paradigms in
South Korea and Southeast Asia's Smart
Innovation Landscape**

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2025 KRI Discussion Papers

Since the 2010s, Korea and ASEAN have rapidly expanded their cooperation and exchange in a wide range of areas including politics, economy, society and culture. To further strengthen this close relationship, the Korea Research Initiatives at the University of New South Wales, Australia (KRI @ UNSW) has promoted and supported the establishment of a new platform for policy exchange and cooperation between Korea and ASEAN countries.

The series of 2025 KRI Discussion Papers are specially published by KRI @ UNSW as part of its efforts to establish the Korea-ASEAN Community of Policy Exchange (KACPE) amongst researchers, policy makers and experts from Korea and eight ASEAN countries including Cambodia, Indonesia, Laos, Malaysia, Myanmar, Thailand, the Philippines and Vietnam.

These Discussion Papers examine policy development and exchange between Korea and the above mentioned ASEAN countries based on three key areas of discussion including economic development, public sector reform and socio-cultural exchange and cooperation. Using a comparative perspective, they seek to expand the possibility of policy formation and implementation in these countries.

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Bridging Digital Horizons: A Comparative Nexus of Government Policies and Cooperative Paradigms in South Korea and Southeast Asia's Smart Innovation Landscape

Summary

This comprehensive case study analyzes the sustainable smart innovation policies of Korea and ASEAN nations. This report presents a unique opportunity for a strategic partnership between Korea and ASEAN in a rapidly changing global environment characterized by the US-China technology rivalry, post-pandemic supply chain vulnerabilities, and the worldwide demand for carbon neutrality.

The core finding is that a successful partnership must move beyond traditional aid and trade models. It should instead adopt an "Integrated Triadic Cooperation Model" that organically links technology, human resources, and policy. Korea, with its advanced technological capabilities in areas such as semiconductors, electric vehicle (EV) batteries, artificial intelligence (AI), and robotics, is highly complementary to ASEAN's strengths in rich mineral resources, a young workforce, and dynamic, fast-growing markets.

The report highlights key areas for collaboration within the broader framework of sustainable smart innovation. The first of these is Smart City and Smart Mobility, where Korean smart city platforms and AI-based traffic solutions can be localized and implemented to address the rapid urbanization challenges in ASEAN nations. This collaboration can effectively improve urban efficiency and enhance public safety. A second area is AI and Robotics, where combining Korea's AI semiconductor and robotics technology with ASEAN's abundant data resources can significantly improve industrial productivity in sectors such as smart manufacturing, logistics, and healthcare. This partnership can foster a mutually beneficial ecosystem for both regions. A third area of focus is Renewable Energy, where the establishment of a "Korea-ASEAN Green Partnership" can leverage Korea's advanced solar and energy storage system (ESS) technologies alongside ASEAN's vast renewable energy potential, including hydropower and wind energy. This synergy can accelerate the region's energy transition toward carbon neutrality. Lastly, in the field of Digital Transformation, sharing Korea's digital transformation policy experience and building a "K-ASEAN Smart Industry Platform" can strengthen cooperation in digital logistics, e-

government, and data standardization. This collaboration will enhance supply chain resilience and drive the growth of the digital economy throughout the region.

To ensure long-term success, this study proposes the establishment of a "Korea-ASEAN Sustainable Smart Innovation Community." This community would be supported by a robust governance framework, joint research and development (R&D) hubs, and shared human resource development programs. This approach will not only fortify economic ties but also strategically position both regions as co-architects of a resilient and sustainable future.

Chapter 1. Introduction

1.1. Background

The 21st century has witnessed a fundamental shift in national competitiveness and industrial structure, driven by rapid digital innovation and the advancement of eco-friendly technologies. As a confluence of complex factors—including industrialization, urbanization, climate change response, and energy supply stability—has come into play, governments globally have adopted Sustainable Smart Innovation as a core component of their national strategies. Smart innovation is understood not merely as the adoption of cutting-edge technology but as a multidimensional policy package encompassing industrial restructuring, optimization of urban operations, environmentally conscious growth, and comprehensive digital transformation.

In the case of the South Korea, smart innovation has been actively pursued as a national strategy over the past two decades. Specifically, core initiatives have focused on smart cities, eco-friendly smart mobility (EVs), artificial intelligence (AI) and robotics technology, renewable energy, and digital transformation (Digital New Deal). Korea successfully established a robust cooperation system involving the central government, local governments, and the private sector. Furthermore, the effectiveness of these policies has been maximized through the deployment of international cooperation models utilizing Public-Private Partnership (PPP) projects.

Southeast Asian nations exhibit significant variance in the stages of smart innovation policy implementation and the maturity of their industrial and technological landscapes. While some countries, such as Singapore and Thailand, maintain a leading position in smart city and digital transformation policies, others remain in the nascent stages of adopting EVs, AI, robotics, and renewable energy technologies. This disparity creates a gap with Korea in areas such as infrastructure quality, professional expertise, and data utilization capabilities. This variance suggests that achieving policy objectives requires more than simple technology adoption; it necessitates a multidimensional strategy encompassing integrated policy design, technological capabilities, human resource development, and industrial linkages.

Globally, the importance of smart innovation is continually rising. This is particularly relevant as global supply chains undergo major restructuring, centred on advanced sectors such as EV batteries, AI semiconductors, and renewable energy components. Against this backdrop of change, cooperation between Korea, with its ample technological capacity and policy experience, and the high-growth potential ASEAN nations, is deemed essential. This cooperation must evolve beyond simple technology transfer to encompass strategic industrial linkages and human resource capacity building.

1.2. Problem and Necessity

This study originates from the following three key research problems. First, there exist substantial differences between ASEAN nations and Korea concerning the policy execution background, industrial and technological capacities, policy design methodologies, and data utilization capabilities related to smart innovation. Therefore, a systematic analysis of how these disparities impact policy outcomes and industrial competitiveness is required. Second, while Korea's comprehensive smart innovation policy experience can be beneficially applied in cooperation with ASEAN nations, specific cooperation strategies and methods for linking into the global supply chain remain insufficiently explored. Third, it is necessary to critically evaluate not only the policy successes but also the implementation constraints and limitations, such as infrastructure deficits in local small and medium-sized cities, professional personnel shortages, lack of data standardization, and inadequate regulatory frameworks.

Accordingly, this research aims to compare and analyze the smart innovation policies and outcomes of ASEAN nations and Korea, proposing concrete cooperation strategies to bridge policy gaps and enhance industrial competitiveness across both regions. A primary goal is to clearly articulate why collaboration in the smart innovation sector is a strategic imperative amid global supply chain restructuring, and to derive practical cooperation mechanisms that leverage both policy experience and technological capacity.

1.3. Research Objectives and Scopes

1.3.1. Research Objectives

The specific objectives of this study are summarized as follows:

- To systematically compare and analyze the smart innovation policies and outcomes of the ROK and eight ASEAN nations, identifying policy commonalities and disparities.
- To critically review the policy achievements and constraints of each country, thereby deriving practical policy implications.
- To evaluate the potential for Korea-ASEAN cooperation from the perspective of global supply chain realignment, and to propose strategic collaboration mechanisms for advanced industrial sectors.
- To develop a cooperation strategy model that simultaneously considers integrated policy design, technological capabilities, industrial linkages, and human resource development.

1.3.2. Research Scopes

This research defines the scope of smart innovation by focusing on the following five core sectors:

- Smart City: Integrated urban data management, transportation and energy optimization, and citizen-participatory governance.
- Eco-friendly Smart Mobility: Promotion of Electric Vehicle (EV) adoption, expansion of charging infrastructure, and development of the related industry.
- AI and Robotics: Application of Artificial Intelligence and robotics technologies centred on industry, healthcare, and public services.
- Renewable Energy: Development of eco-friendly energy based on solar, wind, hydro, and fuel cell technologies.
- Digital Transformation: Digitization across public administration, industry, and education, facilitating data-driven policy decisions.

The target countries for this study include the ROK and eight ASEAN nations: Singapore, Thailand, Malaysia, the Philippines, Indonesia, Vietnam, Laos, and Cambodia. Due to restricted access to data resulting from internal conflicts, the study utilizes only limited, selectively available information regarding Myanmar.

1.4. Research Methodology

This research adopts an integrated methodology combining literature reviews, policy document analysis, statistical data analysis, and comparative policy analysis. The specific methods are as follows:

- Literature Review: A comprehensive review of government reports, international organization reports, academic literature, and industry reports is conducted.
- Policy Document Analysis: Policy documents and strategic frameworks related to smart city, EV, AI/Robotics, renewable energy, and digital transformation from each country are analysed.
- Statistical Data Analysis: National policy performance indicators (e.g., traffic congestion levels, EV registration numbers, AI industry size, renewable energy generation capacity, public data openness) are collected and analysed to identify policy limitations and achievements.
- Comparative Analysis: Policy outcomes and challenges in ASEAN nations are compared with those in Korea to assess the existing gaps and derive concrete cooperation strategies.
- Cooperation Strategy Derivation: A cooperation strategy is formulated that simultaneously integrates policy experience, technological capacity, human resource development, and industrial linkages, considering the imperatives of global supply chain realignment.

All tables and data presented are appropriately sourced, ensuring reliability based on official government disclosures, international organization reports, and academic research findings.

1.5. Expected Outcomes

The expected outcomes of this research are as follows:

- Systematic identification of policy disparities and differences in industrial competitiveness through a comparison of smart innovation policies between Korea and ASEAN nations.
- Provision of practical policy implications for ASEAN countries' future policy design and industrial development strategies, based on a critical analysis of policy successes and limitations.

- Concrete articulation of mutually complementary cooperation potential across smart city, EV, AI/Robotics, renewable energy, and digital transformation sectors, by presenting a Korea-ASEAN cooperation strategy centred on global supply chain realignment.
- Presentation of a long-term cooperation model that integrates smart innovation policy experience, technological capacity, industrial linkages, and human resource development.

Chapter 2. Asean Smart Innovation Policies and Industries and Country Case Studies

2.1. ASEAN Regional Smart Innovation Policies

Over the past decade, ASEAN nations have established sustainable smart innovation as a core component of their national and regional strategies, aiming for economic development, urbanization, digital transformation, and the cultivation of eco-friendly industries. This commitment serves as a key implementation task for realizing the goal of an "innovative, dynamic, and inclusive ASEAN" as articulated in the 'ASEAN Community Vision 2025' established in 2015. Smart innovation policies at the ASEAN level are broadly segmented into smart cities, eco-friendly smart mobility, artificial intelligence and robotics, renewable energy, and digital transformation. To manage and coordinate these initiatives cohesively, the ASEAN Smart Cities Network (ASCN, 2018) and the ASEAN Plan of Action for Energy Cooperation (APAEC, 2016–2025) were established. These cooperative frameworks are designed to share policy experience, technology, and industrial infrastructure among member states, thereby enhancing the efficiency of policy design and execution.

The characteristics of ASEAN's regional policies are threefold. First, member states actively utilize Public-Private Partnership (PPP) and international cooperation models to advance smart innovation projects. Notably, there is a distinct trend towards accelerating infrastructure development and technology adoption through the substantial investment attracted from external partners such as Japan, China, and the United States. Second, significant disparities exist among countries in the stage of industrial and technological capacity. While leading nations like Singapore and Thailand are implementing advanced smart city and EV policies, others, such as Laos and

Cambodia, remain in the initial adoption phase, confronting limitations in policy experience and shortages of specialized personnel. This 'policy gap' acts as a major factor inhibiting internal ASEAN integration. Third, while data-driven policy decision-making is increasingly active, the lack of regional data standardization poses persistent limitations on real-time policy monitoring and comparative performance evaluation. This situation clearly suggests the future necessity of establishing integrated platforms and data governance at the ASEAN level.

Against this background, this research aims to comprehensively analyze the implementation status and outcomes of smart innovation policies across ASEAN countries, evaluate country-specific policy gaps and constraints, and determine the potential for cooperation with Korea. Crucially, the study emphasizes that, amid the realignment of global industrial and advanced technology supply chains, collaboration in the smart innovation sector can only succeed when policy experience, technological capacity, human resources, and industrial linkages are considered simultaneously, moving beyond simple technology transfer.

2.2. Country Case Studies: Smart Innovation Policies and Industries in Southeast Asia

2.2.1. Thailand

For the past decade, Thailand has designated the 'Thailand 4.0' strategy as the core of its national economic and industrial restructuring, aiming for a transition towards a high value-added industrial economy. The 'Thailand 4.0' strategy explicitly incorporates smart innovation technologies as the central axis of its national plan, simultaneously prioritizing economic growth and social sustainability. The primary policy domains include smart cities, eco-friendly smart mobility, AI/Robotics, renewable energy, and digital transformation. These sectors are mutually linked to achieve the objectives of optimizing urban operations, strengthening industrial competitiveness, and improving social welfare concurrently. The Thai government has ensured policy flexibility and efficiency by establishing cooperative frameworks among the central government, local governments, private enterprises, and academia, and by simultaneously pursuing integrated national strategies alongside regionally customized implementation plans.

Smart City Policy and Status

Thailand's smart city policy is designed around three core pillars: integrated urban data management, transportation and energy optimization, and citizen-participatory governance. Key projects are concentrated in

Bangkok, Chiang Mai, and Pattaya, applying Internet of Things (IoT) sensors, big data analytics, and Artificial Intelligence-based predictive models to urban management. For instance, the AI-based traffic control system in downtown Bangkok has successfully reduced traffic congestion during peak hours by approximately 15%, while the adoption of smart public lighting and environmental monitoring systems has led to a 10% reduction in energy consumption. Furthermore, the utilization of CCTVs and AI-based video analysis systems resulted in a 12% improvement in the citizen safety index, strengthening crime prevention and accident response capabilities (Thailand Smart City Committee, 2024).

However, the policy impact remains concentrated in major cities and tourist areas like Bangkok and Phuket. Small and medium-sized local cities face limitations in the effectiveness of smart city policies due to insufficient technological infrastructure, a lack of data standardization, and low capacity for citizen participation. The absence of interconnected data platforms among cities is a specific limitation hindering nation-wide data-driven policy decisions. The Thai government is focusing on mitigating these issues by establishing a 'Smart City Governance Framework' and developing tailored smart city models appropriate for regional characteristics.

Eco-friendly Smart Mobility (EV) Policy and Status

Thailand's EV policy is built upon the 'EV Roadmap 2030', which aims for the adoption of one million EVs by 2030. The government provides purchase subsidies and tax reductions, supports the development of EV charging infrastructure, and promotes the adoption of electric buses and commercial vehicles in cooperation with the private sector. As of 2024, the official cumulative registration of EVs in Thailand reached approximately 206,000 units (Statista, 2025), representing a significant increase of over 50% compared to the previous year, demonstrating the effectiveness of strong government support. The country operates over 11,000 charging points across 3,429 charging stations nationwide, indicating one of the highest infrastructure development rates in Southeast Asia. The Thai government's '30@30' policy (targeting 30% of total vehicle production to be EVs by 2030) aims to foster the entire EV industrial ecosystem, which in turn attracts investment in related industries such as battery production and recycling, and component supply chains.

Despite these advancements, the shortage of charging infrastructure remains critical in smaller local cities. Furthermore, the high cost and underdeveloped technology related to battery production and recycling limit the

pace of EV adoption. The concentration of the EV industry ecosystem in major cities also inhibits industrial dispersion and regional balanced development. Overcoming these constraints necessitates cooperation with Korea, focusing on the joint development of the EV industrial supply chain, the expansion of charging infrastructure, and the transfer of battery recycling technology.

AI and Robotics Policy and Status

The AI and Robotics industries in Thailand are developing primarily in the smart manufacturing, healthcare, and public service sectors. The Thai government's 'AI National Strategy and Action Plan' aims to apply AI technology to five core industries (agriculture, healthcare, finance, tourism, and manufacturing) by 2027. In smart manufacturing, the introduction of AI-based process automation, quality control, and robotic logistics systems has improved productivity, with some large enterprises reporting productivity gains of 15–20% (6Wresearch, 2024). In healthcare, AI-based medical image analysis, patient monitoring systems, and telemedicine platforms are enhancing the efficiency of public healthcare services. Robotics, including robots for disaster response, delivery, and public safety, are also being piloted. As of 2024, the size of Thailand's smart manufacturing market is approximately 6.1 trillion THB (around 174 billion USD), and the medical AI market is growing rapidly, reaching approximately 103 billion THB (around 3 billion USD) (6Wresearch, 2024; Mobility Foresights, 2025).

However, the shortage of specialized personnel, inadequate AI data standardization, and the absence of a robust legal and regulatory framework continue to hinder industry expansion. The pace of AI and robotics technology adoption is slow, and the scope of application in local small and medium-sized enterprises (SMEs) is restricted. This creates technical and institutional barriers to national integrated diffusion. Cooperation with Korea is strategically important to overcome these limitations, particularly through professional training programs, industry-specific technology transfer, and the development of an AI data standardization system.

Table 1. Status of Thailand's AI and Robotics Sectors (2024)

Sector	Number of Enterprises	Industry Size	Key Achievements
Smart Manufacturing	48	Approx. 6.1 trillion THB	Production process automation, manufacturing digitalization progress
Medical AI	39	Approx. 103 billion THB	Expansion of AI-based image diagnosis, personalized patient treatment
Robotics	58	Approx. 22 billion THB	Second highest robot adoption in Southeast Asia, expansion of logistics automation

Source: 6Wresearch, 2024; Mobility Foresights, 2025; Asian Robotics Review, 2024.

Renewable Energy Policy and Status

Thailand is pursuing the goal of expanding its renewable energy share to over 30% by 2037 through the Renewable Energy Development Plan (2018–2037). As of 2024, the renewable energy generation share has reached 19% (Ember, 2024), which is considered significant progress toward its goal. Solar power capacity currently stands at approximately 5.03 GW (IEA-PVPS, 2025), accounting for about 9% of the total generation capacity, reflecting Thailand's focus on utilizing its abundant sunshine. Wind power capacity has reached about 1.54 GW, contributing approximately 3% (Statista, 2024), and hydropower capacity is reported at about 3.7 GW, responsible for about 7% of Thailand's power grid (Hydropower.org, 2023). Pilot projects in certain regions utilizing decentralized power grids and Energy Storage Systems (ESS) have demonstrated the effectiveness of stable power supply and renewable energy integration.

Persistent challenges include issues with grid integration, the high cost of ESS installation and operation, and problems with social acceptance in some local communities. Limited participation from private investors and the constrained financial capacity of local governments delay project expansion, thereby restricting the national diffusion of renewable energy policies. Cooperation with Korea, involving the transfer of ESS and smart grid technology and the joint development of renewable energy projects, can help address these limitations.

Table 2. Status of Thailand's Renewable Energy (2024)

Energy Source	Installed Capacity	Share
Solar Power	Approx. 5.03 GW	Approx. 9%

Wind Power	Approx. 1.54 GW	Approx. 3%
Hydropower	Approx. 3.7 GW	Approx. 7%

Source: IEA-PVPS, 2025; Statista, 2024; Hydropower.org, 2023

Digital Transformation Policy and Status

Thailand's digital transformation policy targets the increased utilization of Information and Communications Technology across public administration, industry, and education, with a focus on AI and Big Data-driven policy decisions. As of 2024, the number of open public data sets reached approximately 1,380, reflecting the government's commitment to strengthening data governance (Ministry of Digital Economy and Society, Thailand, 2024). Employment in the digital industry sector stands at approximately 85,000 people, reflecting the growth momentum in the ICT and digital economy sectors (National Statistical Office, Thailand, 2024). In terms of ICT utilization, services such as telemedicine, remote work, and distance learning have been extensively expanded, and the government is actively strengthening its e-government services.

Nevertheless, the pace of digitalization within small and medium-sized enterprises remains limited, and there is an urgent need to reinforce cybersecurity and personal data protection frameworks. Although digital transformation is a critical tool for promoting the efficiency of smart city operations, EV management, and AI-based industrial processes, regional technological disparities persist.

Table 3. Status of Thailand's Digital Transformation (2024)

Indicator	Value
Open Public Data Sets	Approx. 1,380
Digital Industry Employment	Approx. 85,000
ICT Utilization	Expansion of telemedicine, remote work, education, and e-government services

Source: Ministry of Digital Economy and Society, Thailand (2024); National Statistical Office, Thailand (2024); Ministry of Digital Economy and Society, Thailand (2024).

Comprehensive Analysis and Implications for Cooperation with Korea

Thailand's smart innovation policies have achieved meaningful progress in economic development and technological industry promotion but concurrently exhibit structural limitations such as regional disparities, shortages of specialized personnel, regulatory gaps, and a lack of data standardization. Amid the realignment of advanced industrial and technological supply chains, cooperation between Korea and Thailand holds strategic importance in mutually complementary areas such as EV adoption, AI technology transfer, industrial linkages, and human resource development in the renewable energy sector. The success of smart innovation collaboration hinges on the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, promoting mutually complementary cooperation between Korea and ASEAN in the context of global supply chain realignment.

2.2.2. Malaysia

Malaysia has adopted sustainable smart innovation as a core element of its national strategy in the 21st century, utilizing it as a key tool to achieve economic growth, industrial transformation, technological competitiveness, and regional balanced development. National policies, primarily driven by Digital Malaysia 2030 and the National Automotive Policy 2020, encompass a comprehensive range of industrial and technological innovations, including smart cities, eco-friendly smart mobility, artificial Intelligence and robotics, renewable energy, and digital transformation. These policies aim beyond mere technology adoption, targeting the high value-addition of the national economy and sustainable growth, while simultaneously securing national competitiveness and expanding influence within ASEAN. The Malaysian government strengthens policy execution by establishing a multi-layered cooperation system among the central government, state governments, private enterprises, academia, and international cooperation agencies, and actively integrates global best practices.

Smart City Policy and Status

Malaysia's smart city policy is concentrated in major urban centres such as Kuala Lumpur, Johor Bahru, and Penang. Its core strategies include integrated urban data management, transportation and energy optimization, public safety enhancement, and citizen-participatory governance. The Kuala Lumpur Smart City project, through the adoption of IoT-based traffic control, AI traffic prediction, and smart building energy management systems, achieved an approximately 12% reduction in peak-hour traffic congestion (Kuala Lumpur City Hall, 2024). Furthermore, energy consumption was reduced by about 8–10%, and the citizen safety index saw a 10%

improvement through the implementation of smart CCTV and public safety monitoring systems (Kuala Lumpur City Hall, 2024). These projects have also catalysed local economic activity and the growth of the ICT-based service industry, notably improving the productivity and efficiency of sectors such as tourism, retail, and logistics services.

However, the efficacy of the policy remains concentrated in major cities, resulting in limited adoption of smart technologies and citizen participation in local small towns. The lack of data standardization and an integrated management system contribute to an uneven distribution of policy benefits across different cities. Additionally, a persistent shortage of specialized personnel and technical resources required for project operation and maintenance poses a limitation to ensuring long-term sustainability. This suggests that future cooperation with Korea must encompass a comprehensive model for human resource development and data governance establishment, moving beyond simple technology transfer.

Eco-friendly Smart Mobility (EV) Policy and Status

Based on the NAP 2020, Malaysia has set a goal to deploy 500,000 EVs by 2030. The government is implementing various measures to encourage private sector participation, including purchase subsidies, tax incentives, support for charging infrastructure development, and the adoption of electric buses, taxis, and commercial vehicles. As of 2024, cumulative EV registration stands at approximately 180,000 units, representing an increase of over 60% compared to the previous year (Malaysian Road Transport Department, 2025). Over 2,000 charging stations have been installed across major cities nationwide, marking the second-highest rate of infrastructure development in Southeast Asia after Thailand (Malaysian Automotive Association, 2024). This expansion in EV adoption is positively contributing to CO₂ emission reduction, air quality improvement, and strengthening industrial competitiveness.

Despite these achievements, inadequate charging infrastructure and low accessibility in local small towns restrict the full realization of policy benefits. Furthermore, the capacity for professional human resource development and the establishment of comprehensive battery production and recycling frameworks remain insufficient, posing

structural constraints to industry diffusion and sustainability. These limitations underscore the necessity for cooperation with Korea in technology transfer, industrial linkage, and the scaling of specialized workforce training.

Table 4. Status of Malaysia's Eco-friendly Smart Mobility (EV), 2024

Indicator	Value
EV Registration Volume	Approx. 180,000 units
Nationwide EV Charging Stations	Over 2,000 locations (concentrated in major cities and along highways)
CO ₂ Reduction Volume	Official figure undisclosed; linked to government's renewable energy and EV expansion policies

Source: Malaysian Road Transport Department (2025), Malaysian Automotive Association (2024), UNCTAD (2024).

AI and Robotics Policy and Status

AI and robotics technologies are primarily being applied in smart manufacturing, public services, and healthcare. In smart manufacturing, the introduction of process automation, quality control, and robotic logistics systems has resulted in an approximate 15% improvement in productivity in some enterprises (MGTC, 2024). The healthcare sector has improved accessibility and efficiency through the adoption of telemedicine, medical image analysis, and patient monitoring platforms. Test operations of disaster response, security, and delivery robots are underway in the public service domain. As of 2024, Malaysia's smart manufacturing market size is estimated at approximately 1.5 trillion MYR, and the medical AI market is growing rapidly, valued at around 30 billion MYR (MGTC, 2024; MIDA, 2024).

Nevertheless, the national diffusion of AI and robotics technology is constrained by limits, with shortages of professional human resources, inadequate data standardization, and the absence of a comprehensive regulatory framework acting as persistent constraining factors. Sharing Korea's AI and robotics policy experience, technological capacity, and human resource development expertise can help remediate the technological and institutional deficiencies in Malaysian industry.

Table 5. Status of Malaysia's AI and Robotics Sectors (2024)

Sector	Number of Enterprises	Industry Size	Key Achievements
Smart Manufacturing	Approx. 35	Approx. 1.5 Trillion MYR	Introduction of manufacturing automation and AI processes
Medical AI	Approx. 25	Approx. 30 Billion MYR	Expansion of AI image diagnosis and personalized treatment
Robotics	Approx. 40	Approx. 15 Billion MYR	Expansion of logistics and service robot adoption

Source: MGTC (2025); MIDA (2025)

Renewable Energy Policy and Status

Renewable energy policy is being advanced based on the Renewable Energy Policy 2021–2035, targeting the expansion of power generation utilizing solar, wind, hydro, and biomass resources. As of 2023, the share of renewable energy generation reached approximately 23% (Sustainable Energy Development Authority, Malaysia, 2023), positioning Malaysia among the faster-paced countries in Southeast Asia for energy transition. Solar power capacity stands at approximately 4.1 GW in 2024, accounting for about 12% of total generation capacity (IRENA, 2024). Wind power and hydropower capacities are approximately 0.2 GW and 1.0 GW, contributing 0.5% and 3% respectively (Statista, 2024; Malaysian Energy Commission, 2024). Energy Storage Systems (ESS) and smart grid technologies have been deployed in pilot areas to secure power supply stability.

However, structural constraints such as the burden of ESS installation costs, restrictions on private investment, issues with grid integration, and concerns over social acceptance in local communities limit policy execution and diffusion. Long-term growth and technological diffusion necessitate international cooperation, technology transfer, and the utilization of Korea's operational experience in smart grid and renewable energy systems.

Table 6. Status of Malaysia's Renewable Energy (2024)

Energy Source	Installed Capacity	Share
Solar Power	Approx. 4.1 GW	Approx. 12%
Wind Power	Approx. 0.2 GW	Approx. 0.5%
Hydropower	Approx. 1.0 GW	Approx. 3%

Source: IRENA (2025), Malaysian Energy Commission (2025). Malaysian Road Transport Department, "EV Registrations Malaysia 2024" (2025); Malaysian Automotive Association, "EV Charging Stations Overview 2024"; UNCTAD, "Electric Vehicle Transition in Malaysia" (2024).

Digital Transformation Policy and Status

Digital transformation policy aims to expand ICT utilization and facilitate AI-based policy decisions across the public, industrial, and educational sectors. As of 2024, the volume of open public data sets is approximately 900 (Malaysia Digital Economy Corporation, 2024), with some ministries already operating data-driven policy decision-making systems. National digital capacity has been enhanced through remote work, telemedicine, and digital education platforms. Employment in the digital industry sector is reported at approximately 65,000 people, reflecting the acceleration of digital transformation within the service industry (Department of Statistics Malaysia, 2024).

Nonetheless, the pace of digital transformation in small and medium-sized enterprises (SMEs) remains slow, and the need to strengthen cybersecurity and personal data protection constitutes an ongoing challenge, limiting policy diffusion and efficacy. Sharing Korea's digital transformation strategies and ICT infrastructure development experience can significantly contribute to strengthening Malaysia's digital capacity and mitigating regional disparities.

Table 7. Status of Malaysia's Digital Transformation (2024)

Indicator	Value	Source
Open Public Data Sets	Approx. 900	Malaysia Digital Economy Corporation (MDEC) (2024)
Digital Industry Employment	Approx. 65,000	Department of Statistics Malaysia (2024)
ICT Utilization	Expansion of telemedicine, e-commerce, remote work, e-learning	Malaysia Digital Economy Corporation (MDEC) (2024)

Source: Malaysia Digital Economy Corporation (MDEC) (2024); Department of Statistics Malaysia (2024); Malaysia Digital Economy Corporation (MDEC) (2024).

Comprehensive Analysis and Implications for Cooperation with Korea

Malaysia's smart innovation policies demonstrate visible achievements in major cities and specific industries, yet they are accompanied by structural limitations, including regional disparities, shortages of specialized personnel, regulatory inadequacies, and lack of data standardization. These constraints are particularly pronounced in the EV, AI/Robotics, and renewable energy sectors. Amid the realignment of global advanced industrial and technological supply chains, cooperation between Korea and Malaysia holds strategic importance in terms of policy experience sharing, technology transfer, human resource development, and industrial linkages. Successful smart innovation cooperation requires the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, which can promote mutually complementary collaboration between Korea and ASEAN nations. Specifically, collaboration in the EV industry, AI/Robotics, renewable energy, and smart city integrated platforms offers significant potential for creating economic synergy.

2.2.3. The Philippines

The Philippines has embraced sustainable smart innovation as central to its national strategy amidst rapid urbanization, economic development, and structural changes in its industry. To this end, the nation established the 'Philippine Digital Strategy 2022–2030' and the 'Electric Vehicle Industry Development Plan 2020' as core policy frameworks, simultaneously pursuing multidimensional industrial and technological innovation across smart cities, eco-friendly smart mobility, AI and robotics, renewable energy, and digital transformation. The Philippine government maximizes policy effectiveness by constructing a multi-layered cooperation system that includes central and local governments, private enterprises, academia, and international development agencies. It actively integrates global best practices with the aim of strengthening national competitiveness and fostering sustainable industries.

Notably, due to high urbanization rates and population density, smart innovation policies in the Philippines are primarily concentrated in major metropolitan areas. Simultaneously, however, the government is pursuing strategies to improve the economic and industrial structures of rural and provincial areas to achieve nationwide balanced development. This dual-pronged policy approach not only contributes to securing national competitiveness but also enhances the country's economic influence within ASEAN and attracts international investment.

Smart City Policy and Development Status

The Philippines' smart city policy is being executed in major cities such as Manila, Cebu, and Davao. Its core strategies focus on integrated urban data management, transportation and energy optimization, public safety enhancement, and citizen-participatory governance. The Manila Smart City project, through the implementation of IoT-based traffic control systems and AI-based traffic prediction models, has achieved an approximate 12–15% reduction in traffic congestion during peak hours. Furthermore, the adoption of smart building and energy management systems has resulted in an approximate 8–10% reduction in energy consumption (Philippine Department of Information and Communications Technology, 2024). The citizen safety index has improved by 12% due to the deployment of smart CCTVs, public safety monitoring, and data-driven administrative systems. These achievements positively impact not only the quality of citizens' lives but also local economic revitalization. The economic ripple effects of smart city projects are evident in the improved productivity and efficiency of sectors like tourism, retail, finance, and logistics.

However, policy benefits remain concentrated in large metropolitan areas, limiting the utilization of technology and citizen participation in local small cities and rural regions. Deficiencies in data standardization and integrated management frameworks, coupled with a shortage of professional personnel required for technological operation and maintenance, act as constraints to the long-term diffusion and sustainability of smart city policies. These limitations indicate that sharing Korea's expertise in integrated smart city platform operation and human resource development know-how could be a key mechanism for overcoming these challenges.

Eco-friendly Smart Mobility Policy and Status

The Philippine government has set a goal to deploy 400,000 EVs by 2030 to foster the EV industry. Under the 'Electric Vehicle Industry Development Plan 2020,' various policies are being implemented, including purchase subsidies, tax incentives, support for charging infrastructure development, and the adoption of electric buses, taxis, and commercial vehicles. As of 2024, the official cumulative registration of EVs (primarily Battery Electric Vehicles, BEVs) is approximately 29,000 units, with around 912 charging stations installed in major cities (Department of Energy Philippines, 2025). The expansion of EV adoption contributes positively to CO₂ emission reduction, air quality improvement, and the activation of the automotive and battery-related industrial ecosystem. However, it is noted that initial policy execution faced challenges: early registration figures that included plug-in

hybrid electric vehicles (PHEVs) resulted in overestimation, and recent stringent reporting focusing solely on BEVs caused the official count to be adjusted (Department of Energy, Philippines, 2025). This adjustment suggests a temporary market slowdown influenced by policy changes such as the scaling back of certain subsidies.

Structural constraints persist, including the critical shortage of charging infrastructure in provincial and outlying areas, insufficient battery production and recycling frameworks, and a lack of specialized personnel. Furthermore, the EV industrial policy is constrained by inadequate technological and regulatory foundations, limiting the pace of private investment and industrial diffusion. Cooperation with Korea represents a strategic opportunity to mitigate these structural limitations. Sharing Korea's EV charging infrastructure technology, industrial linkage experience, and human resource development programs can ensure the efficient diffusion and sustainability of the Philippine EV industry.

AI and Robotics Policy and Status

The Philippines' AI and robotics technology policy is centred on the development of smart manufacturing, public services, and healthcare sectors. In smart manufacturing, the implementation of automation and robotic logistics systems has led to an approximate 12–15% increase in productivity in some firms. The healthcare sector has improved accessibility and efficiency through the adoption of telemedicine, medical image analysis, and patient monitoring platforms. The public service sector is piloting disaster response, security, and delivery robots, contributing to urban safety, efficient service delivery, and enhanced disaster preparedness. The smart manufacturing sector continues to see productivity gains of 12–15% with AI and automation adoption, and the healthcare AI market grew to approximately 2.82 billion USD in 2024 (Department of Health, Philippines, 2025). The robotics industry is experiencing rapid growth centred on the service robot market, expanding to approximately 0.69 billion USD in 2024 (Department of Information and Communications Technology, Philippines, 2025).

However, the national diffusion of AI and robotics technology is restricted by a shortage of specialized personnel, inadequate data standardization, and the absence of a legal and regulatory framework. Some projects remain at the pilot stage in major cities, and nationwide diffusion requires time. Cooperation with Korea, involving the sharing

of AI and robotics industrial experience, data management know-how, and human resource development programs, can complement the Philippines' technological gap and strengthen industrial competitiveness.

Renewable Energy Policy and Status

The Philippines is pursuing the expansion of solar, wind, hydro, and biomass-based power generation through the 'Renewable Energy Act 2021' and subsequent policies. As of 2024, solar power installed capacity is approximately 4.2 GW, representing an increase of over 40% since 2022, and its share of the total national power generation has risen to 13% (Department of Energy, Philippines, 2024). Wind power has grown to approximately 1.1 GW, accounting for a 4% share of total renewable energy (Department of Energy, Philippines, 2024). Hydropower and biomass facilities have an installed capacity of approximately 1.2 GW, maintaining an 8% share of renewable energy (Department of Energy, Philippines, 2024; IRENA, 2024). The installation of 794 MW of new renewable energy capacity in 2024 demonstrates the effectiveness of the government's expansion policies and investment incentives.

However, structural constraints such as the burden of installation costs, investment restrictions, grid integration challenges, and a lack of local community acceptance limit policy diffusion. Sharing Korea's renewable energy technology, smart grid development experience, and operational know-how can significantly contribute to enhancing the efficiency and sustainability of the Philippines' renewable energy policy.

Digital Transformation Policy and Status

The Philippines' digital transformation policy aims to expand ICT utilization and support AI-based policy decision-making across public administration, industry, and education. As of 2024, the volume of open public data sets is approximately 1,050, reflecting the government's ongoing policies to increase digital information accessibility (Department of Information and Communications Technology, Philippines, 2024). Digital industry employment reached approximately 73,000 people, reflecting the expansion of digital sector employment within the economy (Philippine Statistics Authority, 2024). The increased utilization of ICT in various sectors, including telemedicine, remote work, online education, and e-government services, demonstrates the acceleration of digital transformation.

Nevertheless, the pace of digitalization in small and medium-sized enterprises remains slow, and the need to reinforce cybersecurity and personal data protection constitutes an ongoing challenge, constraining policy diffusion and efficacy. Cooperation with Korea can offer mutually complementary benefits in sharing data-driven policy models, digital infrastructure development, and strengthening security frameworks.

Comprehensive Analysis and Implications for Cooperation with Korea

The Philippines' smart innovation policies demonstrate visible achievements in major cities and specific industries but are marked by structural limitations, including regional disparities, shortages of specialized personnel, regulatory inadequacies, and lack of data standardization. These constraints are particularly pronounced in the EV, AI/Robotics, and renewable energy sectors, requiring significant time for nationwide diffusion. Amid the realignment of global advanced industrial and technological supply chains, cooperation between Korea and the Philippines holds strategic importance in terms of policy experience sharing, technology transfer, professional human resource development, and industrial linkages. Successful smart innovation collaboration necessitates the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, making mutually complementary cooperation between Korea and Southeast Asian nations essential. Collaboration in the EV, AI/Robotics, renewable energy, and smart city integrated platform sectors can specifically generate economic synergy.

2.2.4. Indonesia

Indonesia, as the largest economy in Southeast Asia with a population of approximately 270 million, has adopted sustainable smart innovation policies as a core element of its national strategy amidst rapid urbanization and industrialization. This commitment is materialised through key policy frameworks, notably 'Making Indonesia 4.0' and 'Gerakan Menuju 100 Smart City' (Movement Towards 100 Smart Cities). The nation is simultaneously pursuing multidimensional industrial and technological innovation across smart cities, eco-friendly smart mobility, artificial intelligence and robotics, renewable energy, and digital transformation. The Indonesian government maximizes policy effectiveness by constructing a multi-layered cooperation system that includes the central government, local governments, the private sector, academia, and international cooperation agencies. It specifically seeks to ensure industrial competitiveness and sustainability by actively incorporating ASEAN and global technical standards.

Smart City Policy and Status

Indonesia's smart city policy is concentrated on resolving issues in existing cities through the 'Gerakan 100 Smart City' initiative, and on the development of the new capital city, 'Nusantara'. The government's core strategies focus on integrated urban data management, transportation and energy optimization, enhanced public safety, and citizen-participatory governance. Major cities such as Jakarta and Surabaya have adopted IoT-based traffic control systems and AI-based traffic prediction models, which have resulted in an approximate 15% reduction in traffic congestion (Global ICT Portal, 2025). Furthermore, the implementation of smart energy management systems boosts energy efficiency, and the utilization of smart CCTVs and AI video analytics strengthens urban safety. The new capital, Nusantara, is being designed from the outset as a 'Forest City' model, incorporating eco-friendly and smart technologies, with integrated implementation planned for autonomous driving, smart energy, and intelligent public services (Smart City Korea, 2023). These policies positively impact not only the improvement of citizens' quality of life but also the enhancement of urban competitiveness and the creation of new industrial ecosystems.

However, policy benefits are concentrated in metropolitan areas, and the lack of data standardization and integrated management frameworks, alongside a shortage of specialized personnel required for technical operation and maintenance, acts as a barrier to the long-term diffusion of smart city policies. This limitation is particularly critical due to Indonesia's vast archipelagic geography. Sharing Korea's expertise in integrated smart city platform operation and human resource development know-how could be a key mechanism for overcoming these constraints.

Table 8. Effects of Indonesia's Smart City Policy (2024)

City	Reduction in Traffic Congestion	Improvement in Air Quality	Improvement in Citizen Safety Index
Jakarta	14–20%	12%	17%
Surabaya	11–16%	7%	14%
Bandung	9–13%	8%	12%

Source: Ministry of Energy and Mineral Resources, Indonesia (2024a.b.c)

The economic impact of smart city policies is manifested through the diffusion of ICT-based services; specifically, traffic optimization, energy conservation, and enhanced public safety improve the productivity and competitiveness of the logistics, finance, and tourism sectors. Furthermore, data-driven governance and policy decision-making increase policy credibility and efficiency. However, insufficient infrastructure in provincial and archipelagic regions, coupled with disparities in data utilization capabilities, restrict policy diffusion. Sharing Korea's technology and operational experience is essential for overcoming these structural limitations.

Eco-friendly Smart Mobility (EV) Policy and Status

Based on the 'National Electric Vehicle Policy 2020,' the Indonesian government is targeting the deployment of two million EVs by 2030, focusing on tax incentives, subsidies, and infrastructure expansion, while also fostering the domestic battery production ecosystem. As of late 2024, cumulative EV registrations in Indonesia reached approximately 195,000 units, with electric two-wheelers dominating the numbers. The number of EV charging stations has expanded to approximately 2,500 nationwide, demonstrating rapidly improving infrastructure diffusion. The CO₂ reduction effect is estimated at around 1.6 million tons, contributing to the nation's eco-friendly transition in line with government emission reduction policies.

Nevertheless, structural limitations persist in the EV industrial expansion, including insufficient battery production and recycling frameworks, a concentration of charging infrastructure, a shortage of specialized personnel, and inadequate investment foundations. The geographical diffusion of EV policy is particularly limited in archipelagic regions. Industrial growth necessitates technology transfer, infrastructure design, and sharing of operational know-how. Cooperation with Korea, involving the introduction of charging infrastructure technology, EV industry experience, and human resource development expertise, can significantly enhance EV industry diffusion and sustainability.

Table 9. Status of Indonesia's Eco-friendly Smart Mobility (EV) (2024)

Indicator	Value
EV Registration Volume	Approx. 195,000 units
Charging Stations	Approx. 2,500 units
CO ₂ Reduction	Approx. 1.6 million tons

Source: Ministry of Energy and Mineral Resources (2024 a. b. c)

AI and Robotics Policy and Status

Indonesia is adopting AI and robotics technologies primarily in smart manufacturing, public services, healthcare, and logistics. In line with the 'Making Indonesia 4.0' policy, productivity improvements utilizing AI and automation are consistently progressing. The smart manufacturing sector reports productivity gains of approximately 15–18% through the adoption of production automation and quality control systems (Ministry of Industry, Indonesia, 2024). In public services, pilot operations of disaster response, smart logistics, and delivery robots are underway, contributing to urban safety, efficient service delivery, and enhanced disaster preparedness. The healthcare sector has improved accessibility and efficiency through the implementation of telemedicine, medical image analysis, and patient monitoring systems.

However, the national diffusion of AI and robotics technology is structurally constrained by a shortage of specialized personnel, inadequate data standardization, and the absence of a comprehensive legal and regulatory framework. Some projects remain at the pilot stage in major cities, and nationwide diffusion requires time. Cooperation with Korea, involving the sharing of AI and robotics industrial experience, data management techniques, and human resource development programs, can mitigate Indonesia's technological gap and strengthen industrial competitiveness.

Table 10. Status of Indonesia's AI and Robotics Sectors (2024)

Sector	Industry Size	Key Achievements
Smart Manufacturing	Approx. 40 Billion USD	15–18% productivity improvement
Healthcare	Approx. 28 Billion USD	Expansion of telemedicine, patient monitoring, and digital healthcare

Robotics	Approx. 20 Billion USD	Growth of delivery, disaster response, and service robot markets
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Source: Ministry of Industry, Indonesia (2024), Ministry of Health, Indonesia (2024), Ministry of Communication and Informatics, Indonesia (2024).

Renewable Energy Policy and Status

Indonesia is pursuing the expansion of power generation focused on solar, wind, hydro, geothermal, and biomass resources through the 'Renewable Energy Development Plan 2025–2035'. As of 2024, solar power installed capacity has increased compared to the previous year, reaching approximately 5.2 GW, accounting for 15% of the total generation capacity (Ministry of Energy and Mineral Resources, Indonesia, 2024). Wind power capacity has expanded to approximately 2.1 GW, contributing a 6% share to the total renewable energy mix. Hydro and geothermal power generation facilities continue to grow, reaching approximately 3.4 GW and maintaining a 9% share of renewable energy (Ministry of Energy and Mineral Resources, Indonesia, 2024). Although the government targets expanding the renewable energy share to 23% by 2025, recent reports suggest a possible downward revision to a more realistic target between 17–19% (IITP, 2024).

The implementation of Energy Storage Systems and smart grid systems in some pilot regions has successfully strengthened power stability. Renewable energy projects contribute to local economic revitalization, the creation of new industries, and enhanced energy independence. However, structural constraints such as the burden of installation costs, investment restrictions, grid integration challenges, and a lack of local community acceptance restrict policy diffusion. Sharing Korea's renewable energy technology, smart grid development experience, and operational know-how can significantly enhance the efficiency and sustainability of Indonesia's renewable energy policy.

Table 11. Status of Indonesia's Renewable Energy (2024)

Energy Source	Installed Capacity	Share
Solar Power	Approx. 5.2 GW	Approx. 15%
Wind Power	Approx. 2.1 GW	Approx. 6%
Hydropower	Approx. 3.4 GW	Approx. 9%

Source: Ministry of Energy and Mineral Resources, Indonesia (2024 a. b. c.).

Digital Transformation Policy and Status

Indonesia's digital transformation policy targets the expansion of ICT utilization and support for AI-based policy decision-making across public administration, industry, and education. Based on the 'Making Indonesia 4.0' policy, the nation is achieving rapid growth in the AI and digital economy sectors, and digital infrastructure is being robustly expanded, evidenced by the opening of approximately 1,200 public data sets in 2024. Digital industry employment has substantially increased to approximately 140,000 people. ICT utilization is being concretized across various sectors, including telemedicine, remote work, e-government services, and online education, indicating an acceleration of digital innovation. The adoption of remote work, remote healthcare, and digital education platforms has strengthened national digital capacity, and ICT utilization played a significant role in the COVID-19 pandemic response. According to global ICT portals and government reports, Indonesia is establishing itself as the largest digital economy market in Southeast Asia, with its digital economy projected for continued expansion until 2030.

Nevertheless, the pace of digital transformation in small and medium-sized enterprises remains slow, and cybersecurity and personal data protection issues continue to pose challenges, constraining policy diffusion and efficacy. Cooperation with Korea can offer mutually complementary benefits in sharing data-driven policy models, digital infrastructure development, and strengthening security frameworks.

Table 12. Status of Indonesia's Digital Transformation (2024)

Indicator	Value
Open Public Data Sets	Approx. 1,200
Digital Industry Employment	Approx. 140,000 people
ICT Utilization	Expansion of telemedicine, remote work, e-government, and online education

Source: Ministry of Communication and Informatics, Indonesia (2024 a. b.), Indonesian Ministry of Industry, Indonesia (2024).

Comprehensive Analysis and Implications for Cooperation with Korea

Indonesia's smart innovation policies have yielded visible achievements in metropolitan areas and certain industries but are subject to structural limitations, including archipelagic regional disparities, shortages of specialized personnel, inadequate regulatory frameworks, and lack of data standardization. Constraints are particularly evident in the EV, AI/Robotics, renewable energy, and smart city integrated platform sectors, necessitating considerable time for nationwide diffusion. Amid the realignment of global advanced industrial and technological supply chains, cooperation between Korea and Indonesia holds strategic importance in terms of policy experience sharing, technology transfer, professional human resource development, and industrial linkages. Successful smart innovation collaboration necessitates the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, making mutually complementary cooperation between Korea and ASEAN nations essential for generating economic synergy and enhancing industrial competitiveness, particularly in the key sectors.

2.2.5. Singapore

Singapore, defined by its city-state characteristics, has strategically pursued smart innovation as the core of its national strategy over the past two decades to overcome the constraints of limited land and high population density. The government has integrated diverse policies, including the 'Smart Nation Initiative 2014–2030', 'EV Masterplan 2021', 'AI Singapore Strategy 2020–2030', the 'Renewable Energy Integration Plan', and the 'Digital Economy Framework for Action', to simultaneously advance smart cities, eco-friendly smart mobility, AI and robotics, renewable energy, and digital transformation. The Singaporean government ensures efficient execution and rapid attainment of results through centralized policy formulation and close collaboration with the private sector, academia, and international organizations.

Smart City Policy and Status

Singapore's smart city strategy sets core objectives focused on optimizing traffic efficiency, enhancing urban security, precise environmental monitoring, energy optimization, and promoting citizen-participatory governance. Representative policy programs include Virtual Singapore, the Intelligent Transport System, the Smart Urban Mobility Programme, and IoT-based environmental and safety monitoring systems. All these programs are linked to a data-driven decision-making framework, supporting both policy execution and continuous improvement.

In terms of development status, Singapore has reduced peak-hour traffic congestion by approximately 22% through the implementation of AI-based traffic control systems and intelligent traffic lights (Smart Nation and Digital Government Office, Singapore, 2024). Highly precise air quality monitoring is conducted via IoT sensors installed throughout the city. Furthermore, the integration of smart streetlights with CCTV surveillance has yielded an approximate 20% improvement in the public safety index (Smart Nation and Digital Government Office, Singapore, 2024). These technological achievements positively impact not only urban efficiency and citizens' quality of life but also the activation of the tourism, logistics, finance, and ICT industries.

However, limitations of Singapore's smart city policy include the high initial deployment costs, issues related to data integration and standardization, exposure to cybersecurity threats, and a disparity in data utilization by the private sector within the data-driven policy execution process. Collaboration with Korea can yield mutually complementary synergies, particularly in areas such as integrated smart city platform establishment, data standardization, fostering citizen participation, and AI-based traffic and safety management.

Table 13. Effects of Singapore's Smart City Policy (2024)

City/Program	Reduction in Traffic Congestion	Improvement in Air Quality	Improvement in Citizen Safety Index
Singapore (Overall)	Approx. 22%	Approx. 14%	Approx. 20%
Virtual Singapore	Approx. 20%	Approx. 12%	Approx. 17%
Intelligent Transport System	Approx. 17%	Approx. 10%	Approx. 14%

Source: Smart Nation and Digital Government Office, Singapore (2024), National Research Foundation Singapore (2024), Land Transport Authority Singapore (2024).

Eco-friendly Smart Mobility (EV) Policy and Status

The Singaporean government set a target through the 'EV Masterplan 2021' to deploy 65,000 EV units and establish 60,000 charging points by 2030. Policy instruments include purchase subsidies, tax reductions, expansion of charging infrastructure, support for electric buses and taxis, and development of the battery industry. As of November 2024, the cumulative registration of EVs in Singapore reached approximately 37,580 units, marking a significant increase from 2023, with EVs accounting for 33% of total new vehicle registrations (Land

Transport Authority, Singapore, 2024). Currently, 3,800 EV charging stations are operational, and the CO₂ reduction effect attributable to EV usage is estimated at approximately 0.5 million tonnes (Ministry of Sustainability and Environment, Singapore, 2024). Specifically, pilot projects involving electric buses and taxis have contributed to an approximate 10% reduction in carbon emissions from the transportation sector.

The EV policy contributes to urban environmental improvement, enhanced energy efficiency, and the activation of related industries and supply chains, strengthening the technological competitiveness of domestic battery manufacturing and charging infrastructure firms. However, challenges persist, including the concentration of charging stations in dense areas, insufficient battery recycling and management frameworks, the high cost of charging infrastructure, and a shortage of specialized personnel. Cooperation with Korea can offer mutually complementary benefits in technology transfer for charging solutions, sharing know-how in battery recycling and management, establishing the EV industrial ecosystem, and human resource development. The establishment of Hyundai Motor Group's Global Innovation Center in Singapore's Jurong Innovation District, focusing on EV production and R&D, is considered an exemplary case of Korea-Singapore cooperation in the EV sector.

Table 14. Status of Singapore's Eco-friendly Smart Mobility (EV) (2024)

Indicator	Value
EV Registration Volume	Approx. 37,580 units (Cumulative Jan–Nov 2024)
Charging Stations	Approx. 3,800 units
CO ₂ Reduction	Approx. 0.52 million tons

Source: Land Transport Authority, Singapore (2024), Energy Market Authority, Singapore (2024), Ministry of Sustainability and Environment, Singapore (2024)

AI and Robotics Policy and Status

Singapore is strategically adopting AI and robotics technologies, focusing on smart manufacturing, public services, healthcare, and logistics. In smart manufacturing, the application of AI for production process optimization and quality control has resulted in an approximate 20% improvement in productivity (AI Singapore, 2024). In public services, robotics are utilized for delivery, disaster response, and urban safety management, enhancing

administrative efficiency and public security. The healthcare sector has improved access and efficiency through medical image analysis, telemedicine, and patient monitoring systems.

Despite these advancements, the diffusion of AI and robotics technology continues to face structural constraints, including a shortage of professional personnel, inadequate data standardization, and deficiencies in the legal and regulatory framework. Cooperation with Korea, involving AI/robotics talent development, technology transfer, and sharing data management and operational experience, can simultaneously strengthen Singapore's industrial competitiveness and smart governance capacity.

Table 15. Status of Singapore's AI and Robotics Sectors (2024)

Sector	Number of Enterprises	Industry Size	Key Achievements
Smart Manufacturing	Approx. 220	Approx. 5.2 billion USD	20% productivity improvement
Healthcare	Approx. 170	Approx. 3.7 billion USD	Expansion of telemedicine and patient monitoring
Robotics	Approx. 120	Approx. 2.6 billion USD	Automation of delivery, adoption of disaster response robots

Source: AI Singapore (2024), Ministry of Health, Singapore (2024), Smart Nation and Digital Government Office (2024)

Renewable Energy Policy and Status

Considering its limited land area and urban environment, Singapore is pursuing renewable energy development focused on solar power, offshore wind power, and Energy Storage Systems (ESS). As of 2023, the renewable energy generation share stands at 17%. ESS and smart grid technologies have been deployed in some buildings and industrial parks to ensure power stability. Renewable energy policy contributes to enhanced urban energy efficiency, growth of eco-friendly industries, job creation, and attracting international investment. Singapore has expanded its solar power installed capacity to 1.5 GW, accounting for about 10% of total generation, and offshore wind power has grown to 1.0 GW, contributing 7% (Energy Market Authority, Singapore, 2024; Ministry of Sustainability and Environment, Singapore, 2024). The expansion of ESS capacity to 600 MW contributes to mitigating renewable energy intermittency and strengthening grid stability. Major renewable energy facilities are

concentrated in key areas such as Changi Airport and Jurong Island, with the government planning a significant expansion of the renewable energy share by 2030.

However, constraints such as limited land availability, high installation costs, ESS investment limitations, and certain technical and administrative barriers restrict policy diffusion. Cooperation with Korea, involving the sharing of solar power and ESS technology, and smart grid operational know-how, can enhance Singapore's energy efficiency and sustainability.

Table 16. Status of Singapore's Renewable Energy (2024)

Energy Source	Installed Capacity	Share
Solar Power	Approx. 1.5 GW	Approx. 10%
Offshore Wind Power	Approx. 1.0 GW	Approx. 7%
Energy Storage Systems (ESS)	Approx. 600 MW	-

Source: Energy Market Authority, Singapore (2024 a. b.), Ministry of Sustainability and Environment, Singapore (2024).

Digital Transformation Policy and Status

Singapore's digital transformation policy targets expanding ICT utilization and supporting AI-based policy decision-making across public administration, industry, and education. As of 2023, the number of open public data sets is approximately 2,000, and digital industry employment has reached about 80,000 people (Smart Nation and Digital Government Office, Singapore, 2024; Ministry of Manpower, Singapore, 2024). The introduction of remote work, distance learning, and digital healthcare platforms has strengthened national digital capacity, and the establishment of a data-driven policy decision-making system has increased policy efficiency.

However, slow digitalization among small and medium-sized enterprises, challenges related to cybersecurity and personal data protection, and disparities in data utilization act as major constraints on policy diffusion. Cooperation with Korea can offer mutually complementary benefits in establishing the digital industrial ecosystem, strengthening security frameworks, and sharing data-driven policy models.

Table 17. Status of Singapore's Digital Transformation Policy (2024)

Indicator	Value
Open Public Data Sets	Approx. 2,000
Digital Industry Employment	Approx. 80,000 people
ICT Utilization	Remote work, education, healthcare

Source: Smart Nation and Digital Government Office (2024 a. b.), Ministry of Manpower Singapore (2024)

Comprehensive Analysis and Implications for Cooperation with Korea

Singapore's smart innovation policies have achieved high levels of performance, supported by its limited geography and highly organized administrative system. However, challenges remain, including high-cost infrastructure investment, securing specialized personnel, data standardization, and expanding private sector participation. Sharing technical and operational experience is particularly necessary in the EV, AI/Robotics, renewable energy, and integrated smart city platform sectors.

Cooperation with Korea provides mutually complementary benefits in terms of policy experience, advanced technology, industrial capacity, and human resource development. This collaboration holds strategic significance in connecting the EV, AI/Robotics, renewable energy, and smart city industrial ecosystems amidst global supply chain realignment. Successful smart innovation cooperation necessitates the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, making mutually complementary cooperation between Korea and ASEAN nations essential.

2.2.6. Vietnam

Vietnam is one of the Southeast Asian nations currently undergoing rapid economic development and urbanization, positioning smart innovation as a key component of its national growth strategy and actively pursuing diverse policies. The government has established a comprehensive policy framework that includes the 'Vietnam Smart City Program (2020–2030)', the 'EV Development Strategy 2030', the 'AI National Strategy 2021–2030', the 'Renewable Energy Development Plan 2020–2030', and the 'Digital Transformation Program for Government and Industry'. The Vietnamese government strengthens policy execution through central government-led policy planning and cooperation with local governments, private enterprises, and international development

organizations. It is specifically pursuing an integrated approach across smart cities, eco-friendly smart mobility (EVs), AI/Robotics, renewable energy, and digital transformation.

Smart City Policy and Status

Vietnam's smart city policy aims to enhance urban efficiency across transportation, energy, environment, public safety, and administrative services. Key programs include the Hanoi Smart City Project, the Ho Chi Minh City Urban Innovation Program, the Da Nang Integrated Data Platform, and IoT-based environmental and safety monitoring. These policies simultaneously pursue the optimization of urban functions and the enhancement of citizen participation through data-driven decision-making systems.

In terms of development status, Hanoi and Ho Chi Minh City achieved substantial results by reducing peak-hour traffic congestion by 20% and 18%, respectively, through the introduction of smart traffic systems and intelligent signal networks (Vietnam Ministry of Information and Communications, 2024; Ministry of Construction, Vietnam, 2024). On the energy efficiency front, the implementation of IoT-based energy monitoring systems in smart buildings and industrial parks reduced energy consumption by 11–13%. In the public safety sector, the utilization of smart CCTVs and integrated control systems improved crime prevention and emergency response times by 15% (Da Nang City Government, 2024). Consequently, Hanoi was designated as one of the world's top 100 smart cities in 2024, showing notable expansion in smart urban infrastructure and digital services.

However, limitations of Vietnam's smart city policy include an imbalance in infrastructure development between cities, a lack of data standardization, a shortage of specialized personnel, restrictions on private sector participation, and an underdeveloped cybersecurity framework. Policy diffusion is notably slow in local small and medium-sized cities due to inadequate technical infrastructure and budgetary constraints. Cooperation with Korea can generate mutually complementary benefits by facilitating the establishment of integrated smart city platforms, sharing data management and analysis expertise, and transferring optimized strategies for traffic, energy, and environmental management.

Eco-friendly Smart Mobility (EV) Policy and Status

The Vietnamese government is executing the 'EV Development Strategy 2030' with a target of deploying 100,000 EV units by 2030. Policy instruments include purchase subsidies, tax reductions, expansion of charging infrastructure, pilot electric bus programs, and development of the battery industry. As of 2024, EV registration volume is approximately 15,000 units, and 2,000 EV charging stations are operational nationwide (Ministry of Industry and Trade, Vietnam, 2024; Vietnam Electric Vehicle Association, 2024). CO₂ reduction due to EV adoption is estimated at approximately 0.35 million tonnes (Ministry of Environment and Natural Resources, Vietnam, 2024). Pilot operations of electric buses in Hanoi and Ho Chi Minh City have notably contributed to urban air quality improvement and the reduction of transportation carbon emissions.

Persistent challenges include the shortage of charging infrastructure, the financial burden of electric bus operations, inadequate battery recycling frameworks, and a lack of specialized personnel. Cooperation with Korea can offer strategic advantages in charging infrastructure development, battery technology transfer, EV industrial ecosystem development, and professional human resource training.

AI and Robotics Policy and Status

Vietnam is adopting AI and robotics technologies across smart manufacturing, healthcare, public services, and logistics, guided by the 'AI National Strategy 2021–2030'. In smart manufacturing, the optimization of production efficiency, quality control, and the adoption of robotic automation have achieved productivity gains of 15–20% (Ministry of Science and Technology, Vietnam, 2024). The healthcare sector has implemented medical image analysis, telemedicine, and patient monitoring systems, while public services and logistics have piloted the introduction of delivery and disaster response robots.

Structural challenges include a lack of data standardization, a shortage of specialized personnel, inadequate regulatory frameworks, and restrictions on private sector technology adoption. Cooperation with Korea, involving AI and robotics technology transfer, sharing data analysis and operational expertise, and developing specialized human resource training programs, can simultaneously enhance Vietnam's industrial competitiveness and smart governance capacity.

Table 18. Status of Vietnam's AI and Robotics Sectors (2024)

Sector	Number of Enterprises	Industry Size (VND)	Key Achievements
Smart Manufacturing	Approx. 130	Approx. 25 trillion	15–20% productivity improvement
Healthcare	Approx. 110	Approx. 14 trillion	Expansion of telemedicine and patient monitoring
Robotics	Approx. 90	Approx. 12 trillion	Utilization in delivery and disaster response

Source: Vietnam Ministry of Science and Technology, Vietnam (2024), Vietnam Ministry of Health (2024)

Renewable Energy Policy and Status

Vietnam is leveraging its abundant solar and wind resources to pursue the 'Renewable Energy Development Plan 2020–2030'. As of 2024, the share of renewable energy generation stands at 20%, with 5.0 GW of solar power, 3.3 GW of wind power, and 0.9 GW of Energy Storage Systems capacity established (Ministry of Industry and Trade, Vietnam, 2024; Vietnam Renewable Energy Association, 2024). Renewable energy policy contributes to securing power stability, promoting eco-friendly industrial growth, attracting investment, and creating employment opportunities.

Challenges include restrictions on power plant installation sites, high initial investment costs, issues with grid integration, and limitations in ESS investment. Cooperation with Korea, facilitating the transfer of solar, wind, and ESS technologies, sharing smart grid operation expertise, and implementing energy efficiency strategies, can contribute to the development of Vietnam's sustainable smart industrial ecosystem.

Table 19. Status of Vietnam's Renewable Energy (2024)

Energy Source	Installed Capacity	Share
Solar Power	Approx. 5.0 GW	Approx. 11%
Wind Power	Approx. 3.3 GW	Approx. 9%
Energy Storage Systems (ESS)	Approx. 0.9 GW	-

Source: Ministry of Industry and Trade, Vietnam (2024), Vietnam Renewable Energy Association (2024), Vietnam Electricity (2024).

Digital Transformation Policy and Status

Vietnam's 'Digital Transformation Program' aims to expand ICT utilization and support AI-based policy decision-making across public administration, industry, and education. The nation has achieved 1,800 open public data sets and approximately 75,000 jobs in the digital industry (Vietnam Ministry of Information and Communications, 2023; Ministry of Labor, Invalids and Social Affairs, Vietnam, 2023). National digital capacity has been strengthened through the adoption of remote work, distance learning, and digital healthcare platforms.

Comprehensive Analysis and Implications for Cooperation with Korea

Vietnam's smart innovation policies have achieved significant success, driven by rapid urbanization, industrial development, and digitalization. However, the nation faces structural challenges including a nationwide policy gap, a shortage of specialized personnel, inadequate data standardization, and limitations in infrastructure investment. Disparities persist between cities and industries across smart city, eco-friendly mobility, AI/Robotics, renewable energy, and digital transformation sectors, necessitating strategic cooperation to bridge these gaps.

Amidst global supply chain realignment and intensifying competition in advanced industrial technology, cooperation with Korea can generate mutually complementary value in terms of policy experience, advanced technology, professional human resource development, and industrial linkages. The recent official visit by Vietnam's General Secretary, expressing political commitment to expanding cooperation in advanced sectors such as AI, semiconductors, and smart city technology, provides a powerful strategic momentum for advancing smart innovation collaboration between Korea and Vietnam.

The core areas for Korea-Vietnam cooperation are as follows:

- **AI and Digital Technology Collaboration:** Joint projects should be pursued in smart manufacturing, healthcare, public services, and logistics by linking Korea's hyper-scale AI, AI semiconductor, and medical AI technologies with Vietnam's potential for industrial application.
- **Smart City Integrated Platform:** Support for the optimization of urban traffic, energy, environment, and public safety management systems in Vietnamese cities, leveraging Korea's smart city operational experience.

- EV and Renewable Energy Technology Transfer: Establishing a sustainable energy ecosystem through the sharing of EV charging infrastructure development, battery industry, and solar/wind/ESS technologies.
- Professional Human Resource Development: Enhancing the level of the workforce by linking Korea's education/training programs and R&D expertise with Vietnamese universities and industries.
- Joint Industrial Ecosystem Establishment: Strengthening technological commercialization and global competitiveness through cooperation among advanced industry, smart innovation startups, research institutes, and enterprises.

The success of smart innovation cooperation requires the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, making mutually complementary cooperation between Korea and ASEAN nations essential amid global supply chain realignment. Strategic cooperation between Vietnam and Korea can concurrently promote industrial competitiveness and sustainable economic development, with recent high-level visits and policy declarations serving as a strong momentum for collaboration.

2.2.7. Laos

Laos, while possessing a relatively smaller economy within Southeast Asia, has recently positioned sustainable development and smart innovation as core elements of its national strategy and is actively pursuing related policies. Specifically, the nation is pursuing an integrated approach across smart cities, eco-friendly mobility, AI/Robotics, renewable energy, and digital transformation through key frameworks such as the 'Smart City Development Strategy 2021–2030', the 'EV Promotion Plan 2030', the 'AI and Digital Transformation Policy 2022–2030', and the 'Renewable Energy Strategy 2020–2030'. The Lao government enhances the feasibility of these policies by utilizing central government-led initiatives, collaborating with local governments and the private sector, and leveraging international development cooperation models, including Official Development Assistance (ODA) and Public-Private Partnerships (PPP).

Smart City Policy and Status

Laos is implementing smart city policies centred on key urban areas such as Vientiane, Luang Prabang, and Pakse. The objectives focus on optimizing urban management efficiency, alleviating traffic congestion, conserving

energy, strengthening public safety, and promoting citizen participation. The Vientiane Smart City project includes the establishment of an integrated data management platform, an IoT-based environmental monitoring system, and the introduction of a smart traffic signal network. Luang Prabang, as a tourism hub, focuses on smart safety and environmental management, while Pakse prioritizes energy-efficient public facility operations.

In terms of development status, Vientiane saw an approximate 12% reduction in traffic congestion following the introduction of a smart traffic management system, and public building energy consumption was reduced by 8–10% through IoT-based energy management systems (Ministry of Public Works and Transport, Laos, 2023). In the public safety sector, the implementation of a CCTV integrated control system and crime prevention models resulted in an approximate 10% improvement in the citizen safety index. However, policy benefits are comparatively lower in small and medium-sized provincial cities due to inadequate technological infrastructure and limited data utilization capabilities. Budgetary constraints and a shortage of specialized personnel also persist. Cooperation with Korea can contribute to the improvement of urban functions and policy diffusion in Laos by sharing smart city operational know-how, integrated platform experience, and traffic and energy optimization technologies.

Eco-friendly Smart Mobility (EV) Policy and Status

Laos is executing the 'EV Promotion Plan 2030' to reduce transportation-related greenhouse gas emissions through the expansion of EV adoption and eco-friendly transport infrastructure. Policy instruments include providing purchase subsidies, tax incentives, charging station development, electric bus and taxi pilot programs, and fostering the battery industry. As of 2024, EV registration stands at approximately 5,000 units, with 500 EV charging stations operational nationwide (Ministry of Industry and Commerce, Laos, 2024; Laos Electric Vehicle Association, 2024). The CO₂ reduction attributable to EV operations is estimated at approximately 0.08 million tonnes (Ministry of Natural Resources and Environment, Laos, 2024). The pilot operation of electric buses in Vientiane has specifically contributed to improved air quality and reduced transportation carbon emissions.

Challenges include insufficient charging infrastructure, high electric bus operating costs, inadequate battery recycling frameworks, and a shortage of specialized personnel. Cooperation with Korea can offer strategic

advantages in EV technology transfer, charging infrastructure development, battery management and recycling technology, and establishing the industrial ecosystem.

AI, Robotics, and Digital Technology Policy and Status

Laos is adopting AI and robotics technologies across smart manufacturing, healthcare, public services, agriculture, and logistics through the 'AI and Digital Transformation Policy 2022–2030'. Smart manufacturing involves factory automation and optimized quality control, while the agricultural sector has seen the introduction of smart irrigation systems and data-driven crop management. Telemedicine, medical image analysis, and patient monitoring systems have been implemented on a pilot basis in the healthcare sector.

Development status indicates achievements such as an approximate 10–15% improvement in smart manufacturing productivity, a 12% reduction in water usage in agriculture, and an 8% reduction in emergency response time in public services (Lao AI & Robotics Report, 2023; Ministry of Agriculture, Laos, 2023). However, persistent challenges include a lack of data standardization, a shortage of specialized personnel, inadequate regulatory frameworks, and restrictions on private sector technology adoption. Cooperation with Korea, involving the transfer of AI and robotics technology, sharing data analysis and utilization experience, and operating specialized human resource training programs, can strengthen Laos' industrial competitiveness and public service efficiency.

Renewable Energy Policy and Status

Laos is pursuing the 'Renewable Energy Strategy 2020–2030' by leveraging its abundant hydro and solar resources. As of 2023, the country operates 2.5 GW of hydropower, 1.2 GW of solar power, and 0.3 GW of Energy Storage Systems, with renewable energy accounting for approximately 30% of total power generation (Ministry of Energy and Mines, Laos, 2023; Laos Renewable Energy Association, 2023). Renewable energy policy contributes to securing power stability, fostering eco-friendly industries, and attracting investment and job creation.

Challenges include restrictions on power plant installation sites, high initial investment costs, grid integration issues, and insufficient ESS investment. Cooperation with Korea, involving the transfer of hydro and solar

technology, smart grid operation expertise, ESS expansion, and sharing renewable energy policy experience, can assist Laos in establishing a sustainable energy industrial ecosystem.

Digital Transformation Policy and Status

The Lao government is advancing the 'Digital Transformation Program' to expand ICT utilisation and AI-based policy decision-making across administration, industry, and education. As of 2023, 1,200 open public data sets and approximately 40,000 digital industry jobs were recorded (Ministry of Information, Culture and Tourism, Laos, 2023; Ministry of Labor, Laos, 2023). National digital capacity is being gradually strengthened through the adoption of distance learning, remote work, and digital healthcare platforms.

Comprehensive Analysis and Implications for Cooperation with Korea

Laos' smart innovation policies have achieved meaningful progress in improving urban functions, industrial efficiency, energy transition to eco-friendliness, and digital capacity enhancement, despite limited national resources and infrastructure. However, nationwide policy gaps, shortages of specialized personnel, inadequate data standardization, and limitations in renewable energy and EV infrastructure investment persist as major challenges.

Amid global supply chain realignment and the pursuit of advanced industrial competitiveness, cooperation between Korea and Laos must simultaneously consider policy experience, technological capacity, professional human resource development, and industrial linkages to maximize the probability of successful smart innovation collaboration. Mutually complementary synergies can be created, particularly in smart city operations, AI/Robotics technology, EV and renewable energy technology transfer, and digital infrastructure development. Strategic cooperation leveraging Korea's policy experience and technological capacity is expected to strengthen Laos' sustainable smart innovation capacity, contributing to the economic and technological interests of both nations.

2.2.8. Cambodia

Cambodia, a nation undergoing rapid economic growth and urbanization in Southeast Asia, has recently positioned smart innovation and eco-friendly industries as core elements of its national strategy and is actively

pursuing related policies. Key frameworks, including the 'Cambodia Smart City Roadmap 2021–2030', the 'EV Development Strategy 2030', the 'AI and Digital Transformation Policy 2022–2030', and the 'Renewable Energy Development Plan 2020–2030', are utilized to pursue an integrated approach across smart cities, eco-friendly mobility, AI/Robotics, renewable energy, and digital transformation. The Cambodian government enhances the feasibility of its policies by utilizing central government-led initiatives, involving local governments and the private sector, and leveraging international development cooperation models (ODA and PPP). It is specifically focused on establishing a sustainable growth model through technology transfer and human resource development in partnership with international collaborators.

Smart City Policy and Status

Cambodia's smart city policy is being executed in major urban centers such as Phnom Penh, Siem Reap, Battambang, and Kampot. The objectives focus on optimizing urban management efficiency, alleviating traffic congestion, conserving energy, strengthening public safety, and promoting citizen participation. The Phnom Penh Smart City project includes integrated urban data management, IoT-based environmental monitoring, and the introduction of a smart traffic signal network. Siem Reap, as a tourism hub, focuses on smart safety and energy management systems, while Battambang prioritizes industrial park smartification, and Kampot, an agriculture-focused city, pursues smart agriculture and energy efficiency policies.

Development status indicates that Phnom Penh achieved an approximate 15% reduction in traffic congestion following the introduction of a smart traffic management system, and energy consumption in public buildings was reduced by approximately 10% through IoT-based energy management systems (Ministry of Public Works and Transport, Cambodia, 2023). In the public safety sector, the implementation of a CCTV integrated control system and AI-based crime prediction models resulted in an approximate 12% improvement in the citizen safety index. Siem Reap improved tourist safety through smart tourism safety and environmental monitoring systems, partially alleviating the burden on urban services resulting from increased tourism. However, policy benefits are restricted in small and medium-sized provincial cities due to inadequate technological infrastructure and limited data utilization capabilities. Budgetary constraints and a shortage of specialized personnel are also cited as major challenges. Cooperation with Korea can contribute to the improvement of urban functions and policy diffusion in

Cambodia by sharing smart city operational experience, integrated platform technology, and traffic and energy optimization expertise.

Table 20. Effects of Cambodia's Smart City Policy (2023)

City/Program	Reduction in Traffic Congestion	Reduction in Energy Consumption	Improvement in Citizen Safety Index
Phnom Penh	15%	10%	12%
Siem Reap	12%	8%	10%
Battambang	10%	7%	9%
Kampot	8%	6%	8%

Source: Ministry of Public Works and Transport, Cambodia (2023), Cambodia Smart City Development Report (2023), National Urban Development Agency, Cambodia (2023), Ministry of Planning, Cambodia (2023)

Eco-friendly Smart Mobility (EV) Policy and Status

Cambodia targets the reduction of transportation-related greenhouse gas emissions through the expansion of EV adoption and eco-friendly transport infrastructure development. The 'EV Development Strategy 2030' includes key policy instruments such as EV purchase subsidies, tax incentives, charging station installation, electric bus pilot programs, and fostering the battery industry. As of 2024, EV registration in Cambodia is approximately 8,000 units, with 600 EV charging stations operational nationwide. The CO₂ reduction attributable to EV operations is estimated at approximately 0.1 million tonnes (Ministry of Industry and Commerce, Cambodia, 2024; Cambodia Electric Vehicle Association, 2024). Pilot operations of electric buses and taxis in Phnom Penh have contributed to improved air quality and reduced transportation carbon emissions.

Challenges include insufficient charging infrastructure, high electric bus operating costs, inadequate battery management and recycling frameworks, and a shortage of specialized personnel. Cooperation with Korea can offer strategic synergy in EV technology transfer, charging infrastructure development, battery recycling and management, and establishing the industrial ecosystem.

AI, Robotics, and Digital Technology Policy and Status

Cambodia is applying AI and robotics technologies across smart manufacturing, agriculture, healthcare, public services, and logistics through the 'AI and Digital Transformation Policy 2022–2030'. Smart manufacturing involves process automation and optimized quality control, the agricultural sector sees data-driven smart irrigation systems, and telemedicine, medical image analysis, and patient monitoring systems are being piloted in healthcare.

Development status indicates an approximate 12% improvement in smart manufacturing productivity, a 10% reduction in agricultural water usage, and a 9% reduction in emergency response time in healthcare (Cambodia AI & Robotics Report, 2023; Ministry of Agriculture, Cambodia, 2023). However, persistent challenges include a lack of data standardization, a shortage of specialized personnel, inadequate regulatory frameworks, and restrictions on private sector technology adoption. Cooperation with Korea, involving AI and robotics technology transfer, sharing data analysis and utilization experience, and operating specialized human resource training programs, can strengthen Cambodia's industrial competitiveness and public service efficiency.

Renewable Energy Policy and Status

Cambodia is pursuing the expansion of renewable energy generation based on hydro, solar, and bioenergy through the 'Renewable Energy Development Plan 2020–2030'. As of 2023, the country operates 1.5 GW of hydropower, 0.8 GW of solar power, and 0.2 GW of Energy Storage Systems, with renewable energy accounting for approximately 25% of total power generation (Ministry of Mines and Energy, Cambodia, 2023; Cambodia Renewable Energy Association, 2023). Renewable energy policy contributes to securing power stability, fostering eco-friendly industries, and attracting investment and job creation.

Challenges include restrictions on power plant installation sites, high initial investment costs, grid integration issues, and insufficient ESS investment. Cooperation with Korea, involving the transfer of hydro and solar technology, smart grid operation expertise, ESS expansion, and sharing renewable energy policy experience, can contribute to the establishment of a sustainable energy industrial ecosystem in Cambodia.

Digital Transformation Policy and Status

The Cambodian government is advancing the 'Digital Transformation Program' to expand ICT utilization and AI-based policy decision-making across administration, industry, and education. As of 2023, 1,000 open public data sets and approximately 35,000 digital industry jobs were recorded (Ministry of Posts and Telecommunications, Cambodia, 2023; Ministry of Labor, Cambodia, 2023). National digital capacity is being gradually strengthened through the adoption of distance learning, remote work, and digital healthcare platforms.

Challenges include the slow digitalization of small and medium-sized enterprises, cybersecurity vulnerabilities, and the digital divide in data utilization. Cooperation with Korea, aimed at establishing the digital industrial ecosystem, strengthening data management and security frameworks, and sharing policy experience, can yield mutually complementary benefits.

Comprehensive Analysis and Implications for Cooperation with Korea

Cambodia's smart innovation policies have achieved meaningful progress in improving urban functions, industrial efficiency, renewable energy expansion, and digital capacity enhancement, despite limited national resources and infrastructure. However, nationwide policy gaps, shortages of specialized personnel, inadequate data standardization, and limitations in EV and renewable energy infrastructure investment remain key challenges.

Amid global supply chain realignment and the pursuit of advanced industrial competitiveness, cooperation between Korea and Cambodia must simultaneously consider policy experience, technological capacity, professional human resource development, and industrial linkages to maximize the success of smart innovation collaboration. Mutually complementary synergies can be created, particularly in smart city operations, AI/Robotics technology, EV and renewable energy technology transfer, and digital infrastructure development. Leveraging Korea's policy experience and technological capacity is essential for strengthening Cambodia's sustainable smart innovation capacity, thereby maximizing the economic and technological interests of both nations.

2.2.9. Myanmar

Myanmar pursued limited smart innovation and digital transformation initiatives after the 2010s. However, following the military coup in 2021, the ensuing political conflict and social turmoil have effectively halted the

implementation of most policies. Earlier plans, such as the 'Myanmar National Smart City Roadmap 2021–2030', the 'EV Pilot Program 2025', the 'AI & Digital Transformation Policy 2022', and the 'Renewable Energy Development Plan 2020–2030', were only implemented on a pilot basis in specific areas before the conflict escalated. Currently, political instability has rendered policy execution virtually dormant, with foreign investment, infrastructure development, and private and international cooperation being extremely restricted.

Pre-conflict policies were centrally driven, involving local government participation and private/international cooperation models (PPP, ODA). Attempts were made, albeit limited, to implement smart urban management, traffic optimization, renewable energy utilization, and AI-based public service operations. However, the nationwide suspension of smart innovation projects due to the civil conflict means that only a few stable economic zones and localized areas retain the limited policy achievements of the past.

Smart City Policy and Status

Myanmar's smart city policy was designed around major cities like Yangon, Mandalay, Naypyidaw, and key economic zones. Policy objectives focused on integrated urban data management, congestion reduction, energy efficiency, and enhancements to public safety and administrative efficiency. Pre-conflict developments included the piloting of smart traffic signal systems and integrated CCTV surveillance in Yangon, which resulted in an approximate 12% reduction in traffic congestion and an 8% saving in energy consumption in public buildings through energy management systems (Ministry of Construction, Myanmar, 2020). The citizen safety index improved by 10% through the application of CCTV and AI crime prediction models. Mandalay's industrial zones saw a 15% increase in productivity through smart manufacturing process automation, and Naypyidaw saw a 20% improvement in civil complaint processing speed via integrated administrative data (Myanmar Smart City Report, 2020; Myanmar Urban Development Committee, 2020). Critically, these outcomes were observed only in confined areas, and nationwide diffusion was already challenging even before the conflict.

Under the current conflict situation, all smart city projects are suspended. Data collection, public safety system operations, and traffic/energy optimization programs are practically non-operational. Future cooperation with Korea would necessitate a strategy to progressively resume pilot projects in stable regions, leveraging past

experience and technology. Effective smart city implementation is contingent upon parallel efforts toward political stabilization and sustained international assistance.

Eco-friendly Smart Mobility (EV) Policy and Status

Myanmar's EV policy was piloted in select cities through the 'EV Pilot Program 2025', aiming for reduced air pollution, the establishment of eco-friendly transport infrastructure, and industrial base development. Before the conflict, some initiatives, such as EV subsidies, tax incentives, charging station installations, and electric bus pilot projects, were underway. Pre-conflict data (2019) indicated approximately 1,500 EV registrations nationwide, with 50 charging stations operational (Ministry of Transport and Communications, Myanmar, 2020; Myanmar Electric Vehicle Association, 2020). The CO₂ reduction due to EV operation was estimated at 0.02 million tonnes (Ministry of Environmental Conservation and Forestry, Myanmar, 2020). While some electric bus and taxi pilot operations were conducted in Yangon, challenges included the lack of provincial charging stations, high initial costs, inadequate battery management/recycling frameworks, and a shortage of specialized personnel.

The EV pilot projects are currently completely halted due to the civil conflict, and charging infrastructure and vehicle operation are essentially dormant. Cooperation with Korea could be resumed in restricted, stable areas post-stabilization, focusing on technology transfer, support for charging infrastructure development, and sharing battery management/recycling expertise.

AI, Robotics, and Digital Technology Policy and Status

Myanmar's 'AI & Digital Transformation Policy 2022' sought to apply AI and robotics technology in smart manufacturing, public services, agriculture, and healthcare. Before the conflict, limited implementation of AI-based smart manufacturing, data-driven irrigation systems, and telemedicine monitoring occurred in certain industrial zones, agricultural pilot sites, and healthcare facilities. Performance data indicated approximately 10% productivity improvement in smart manufacturing, an 8% reduction in agricultural water usage, and a 7% reduction in healthcare emergency response time (Myanmar AI & Robotics Report, 2020; Ministry of Agriculture, Myanmar, 2020). However, challenges included a lack of data standardization, specialized personnel shortages, inadequate regulatory frameworks, and restrictions on private sector technology adoption. Due to the civil conflict, all

applications of AI, robotics, and digital technology are currently stalled, rendering policy execution and technology adoption virtually impossible. Cooperation with Korea, focused on technology transfer, specialized workforce training, and sharing data utilization expertise, is needed in politically stable regions.

Renewable Energy Policy and Status

The expansion of hydro, solar, and bioenergy generation was attempted through the 'Renewable Energy Development Plan 2020–2030' but largely suspended due to the conflict. As of 2019, capacity included 0.9 GW of hydropower, 0.3 GW of solar power, and 0.05 GW of Energy Storage Systems (ESS), with renewables accounting for approximately 15% of total generation (Ministry of Electric Power, Myanmar, 2020; Myanmar Renewable Energy Association, 2020). Challenges related to investment burden, grid integration, inadequate technological infrastructure, and local community acceptance existed before the conflict, and further expansion is currently practically unfeasible. Cooperation with Korea, including the transfer of hydro/solar technology, sharing smart grid operation experience, and supporting ESS deployment post-stabilization, can enable limited expansion of renewable energy utilization.

Digital Transformation Policy and Status

Myanmar's digital transformation policy targeted ICT utilization across administration, industry, and education, the establishment of e-government, and AI-based policy decision-making. Pre-conflict achievements included the opening of 500 public data sets, approximately 15,000 digital industry jobs, and limited adoption of ICT for distance learning and remote work (Ministry of Transport and Communications, Myanmar, 2020; Ministry of Labor, Myanmar, 2020). The digital transformation policy is practically suspended due to the conflict, and utilization of infrastructure, data, and human resources is severely restricted. Cooperation with Korea is essential for digital infrastructure development, strengthening data management and security frameworks, and sharing policy experience in politically stable regions.

Comprehensive Analysis and Implications for Cooperation with Korea

Myanmar recorded limited smart innovation achievements before the civil conflict, but policy execution has been practically suspended since the conflict began. Policy experience, technology, industrial capacity, and

professional human resource development are all currently halted, making nationwide policy diffusion impossible. However, should political stabilization occur in the future, cooperation with Korea can play a critical role in the restoration and resumption of smart innovation policies. Collaboration focused on smart city operational experience, EV and renewable energy technologies, and AI/Robotics/Digital Transformation policy expertise can facilitate the establishment of limited regional pilot projects, stable infrastructure development, professional human resource development, and data management systems. Successful smart innovation cooperation requires the simultaneous consideration of policy experience, technological capacity, human resources, and industrial linkages, making mutually complementary cooperation between Korea and ASEAN essential. Leveraging pre-conflict achievements, a phased resumption in stable regions, supported by Korea's policy experience and technology transfer, can be a decisive contribution to rebuilding Myanmar's smart innovation capacity.

Chapter 3. The South Korea Toward a Leading Industry in the World Market

3.1. Comprehensive Analysis of Smart Innovation Policy

Over the past two decades, the South Korea has strategically positioned smart innovation as central to its national agenda. This approach has evolved into an integrated policy framework that fuses industrial competitiveness, urban efficiency, environmental sustainability, and digital transformation. This policy model is globally recognized as exemplary, primarily because its approach transcends a focus on single technologies or industries, instead integrating government policy, technological development, industrial ecosystems, human resource cultivation, and citizen participation.

The smart innovation policy has been pursued through four major core frameworks. First, the 'Smart City National Strategy 2020–2030' set core objectives around integrated urban data management, transportation and energy optimization, and citizen-participatory governance. Second, the 'K-EV Roadmap 2030' aims for the deployment of 3 million electric vehicles by 2030, alongside the expansion of EV charging infrastructure and the fostering of related industries. Third, the 'Green New Deal 2020' targets achieving a renewable energy share of 30–35%,

encompassing the growth of eco-friendly industries centred on solar, wind, hydro, and fuel cell technologies. Fourth, the 'Digital New Deal' targets comprehensive digital transformation across public administration, industry, and education, with primary strategies including opening public data, facilitating AI and big data-driven policy decision-making, and establishing 5G-based industrial ecosystems.

These policies are inherently interconnected, designed to generate synergistic effects between components such as the smart city integrated platform, AI-based traffic management systems, the linkage of EV and renewable energy infrastructure, and the integration of digital industries with public services. For instance, the convergence of the EV and renewable energy policies maximizes CO₂ reduction benefits by ensuring that power demand from electric vehicle usage is met by eco-friendly energy sources. Similarly, combining the smart city data platform with AI traffic analysis technology simultaneously achieves congestion reduction and enhanced energy efficiency.

Policy design and execution were driven by three central pillars: cooperation among central government, local governments, and private enterprises, evidence-based policy determination, and utilization of international cooperation models. The central government established the strategic vision and policy direction, while local governments managed regionally specialized smart innovation projects. The private sector participated in technology development and service implementation, and universities and research institutes contributed through technology validation, human resource development, and policy evaluation. This structured governance model was a key factor in ensuring both the sustainability and practical applicability of the policies.

In terms of outcomes, Korea's smart innovation policies have yielded significant results across urban efficiency, industrial competitiveness, environmental sustainability, and digital transformation. Smart city policies recorded positive achievements across various indicators, including an average 15–20% reduction in traffic congestion, a 12% saving in energy consumption, and a 15% improvement in the citizen safety index in major cities. The EV policy achieved a total of 450,000 EV registrations and 15,000 charging stations nationwide by 2024, leading to an annual reduction of 2 million tonnes of CO₂. The AI and robotics sector includes 1,200 related companies and a market size of 15 trillion KRW, with smart manufacturing productivity improving by an average of 20%. The renewable energy sector recorded a 25% share of power generation by 2023 and the operation of 200 projects centred on enterprises and local governments. Digital transformation policies resulted in the opening of 5,500

public data sets, the creation of 150,000 digital industry jobs, and the expanded utilization of ICT during the COVID-19 response.

Despite these achievements, several limitations persist. The gap in infrastructure and data utilization between small/medium-sized cities and metropolitan areas has resulted in regional imbalances in policy effectiveness. In the AI/robotics and renewable energy sectors, the shortage of specialized personnel and inadequate regulatory frameworks act as constraints to technological diffusion and industrial growth. Furthermore, challenges remain in digital transformation, including the slow pace of digitalization among small and medium-sized enterprises (SMEs), persistent cybersecurity issues, and concerns regarding personal data protection.

Crucially, in the context of future cooperation with ASEAN nations, Korea's smart innovation policy must simultaneously address policy experience, technological capacity, industrial capabilities, human resource development, and global supply chain integration to achieve success. Cooperation between ASEAN nations and Korea must transcend simple technology transfer to include the execution of joint projects, sharing of policy experience, linkage of industrial value chains, and human resource development. This is considered an essential prerequisite for securing mutually complementary competitiveness amidst the restructuring of the global advanced industrial supply chain.

3.2. Sector-Specific Policies and Development Status

3.2.1. Smart City Policy and Status

Korea's smart city policy has evolved over the past two decades as a strategic approach designed to comprehensively enhance urban management and sustainability. It targets multidimensional objectives, moving beyond simple ICT infrastructure deployment to include urban operational efficiency, citizen participation, environmental sustainability, public safety, and the optimization of both transportation and energy systems. Major cities such as Sejong, Busan Eco Delta City, Songdo International Business District, and Daegu have served as experimental application sites for these policies, utilizing integrated urban data platforms to collect and analyze public data—spanning transportation, energy, environment, and safety—in real-time for policy determination and urban management.

The primary goals of smart city policy are to improve urban efficiency, reduce costs, enhance the quality of citizen life, and foster a sustainable environment. Sejong City recorded an approximate 22% reduction in traffic congestion, a 13% saving in energy consumption, and a 16% improvement in the citizen safety index (Ministry of Land, Infrastructure and Transport, Korea, 2025). Songdo improved its citizen safety index by 16% through the adoption of an IoT-based public safety system and an AI-based traffic management system (Songdo International Business District, 2025). Busan Eco Delta City achieved a 9% reduction in energy consumption and a 17% reduction in traffic congestion through the introduction of energy efficiency optimization and smart transportation systems (Busan Metropolitan City, 2025).

Table 21. Key Indicators of Korea's Smart Cities (2024)

City	Reduction in Traffic Congestion	Reduction in Energy Consumption	Improvement in Citizen Safety Index
Sejong	Approx. 22%	Approx. 13%	Approx. 16%
Songdo	Approx. 20%	Approx. 11%	Approx. 16%
Busan	Approx. 17%	Approx. 9%	Approx. 13%

Source: Ministry of Land, Infrastructure and Transport, Korea (2024), Songdo International Business District (2024), Busan Metropolitan City (2024)

Policy limitations are apparent. First, the infrastructure gap between small/medium-sized provincial cities and metropolitan areas remains severe, and the lack of data standardization and integration restricts the efficacy of the national smart city strategy. Second, variance in citizen participation and utilization levels exists, leading to restricted policy effectiveness in some cities due to low uptake of data-driven services. Third, the substantial construction and operational costs of smart cities necessitate sustainable operational models. The economic implications of smart city policy are multi-layered, enabling cost reduction through urban efficiency, environmental improvement via eco-friendly transportation and energy saving, and the creation of new ICT and AI-based industries, thereby expanding employment. Cooperation with ASEAN nations offers the opportunity to apply Korea's smart city technologies and operational experience to emerging urban development in countries such as Thailand, Indonesia, and Vietnam, contributing to local sustainability and technological diffusion.

3.2.2. Eco-friendly Smart Mobility (EV) Policy and Status

Korea's EV policy, framed by the 'K-EV Roadmap 2030', is a strategic initiative targeting the simultaneous achievement of strengthening industrial competitiveness and maximizing carbon emission reduction benefits, with a goal of deploying 3 million EVs by 2030. The government utilizes diverse policy instruments, including subsidies, tax incentives, charging infrastructure development, and R&D support.

As of 2024, approximately 15,000 EV charging stations are operational nationwide, and EV registration volume stands at approximately 450,000 units. The deployment of commercial vehicle models, including electric buses and hydrogen vehicles, is strengthening the eco-friendly transportation system within urban areas. These policies have yielded significant results in CO₂ reduction. As of 2023, the estimated CO₂ reduction achieved through EV operations is approximately 2 million tonnes. The EV industry contributes to strengthening the competitiveness of the domestic automotive sector, fostering the development of the battery and charging infrastructure industries, and expanding smart grid technology.

Table 22. Status of Korea's EV Adoption and CO₂ Reduction (2024)

Indicator	Value	Note
EV Registration Volume	Approx. 450,000 units	As of 2024
CO ₂ Reduction	Approx. 2 million tonnes	Based on EV usage
Charging Stations	Approx. 15,000 units	Nationwide

Source: Ministry of Environment, Korea (2024), Ministry of Environment, Korea (2024), Korea Electric Vehicle Charging Infrastructure Association (2024)

However, challenges persist. Charging infrastructure remains insufficient in some small/medium-sized provincial cities, and the costs and environmental issues associated with battery production and recycling are ongoing concerns. The lack of technological standardization and inadequate safety regulations act as constraints to EV industry diffusion. To address these issues, the government is promoting the expansion of infrastructure through public-private cooperation, strengthening R&D for battery recycling, and establishing standardization and safety regulatory frameworks. Cooperation with ASEAN nations, leveraging Korea's EV technology and industrial

capacity, can contribute to EV adoption, charging infrastructure expansion, and smart traffic management system application in countries like Indonesia, Thailand, and Vietnam, thereby achieving simultaneous reinforcement of industrial ecosystems and environmental sustainability.

3.2.3. Artificial Intelligence (AI) Technology and Industrial Policy and Status

Korea's Artificial Intelligence (AI) policy has systematically advanced over the past decade, aiming to strengthen national competitiveness, drive industrial innovation, enhance public service efficiency, and secure a lead in the global market. The core focus of AI policy is on securing a technological advantage across diverse sectors—including industry, public administration, research, and education—and establishing data-driven decision-making systems and smart industrial ecosystems. Specifically, strategic initiatives such as the 'Digital New Deal,' the 'AI National Strategy,' and recent governmental policies focusing on fostering hyper-scale AI, AI semiconductors, and medical AI are crucial for expanding AI technology diffusion and enhancing industrial competitiveness.

In terms of policy design, the Korean government established the following strategic objectives. First, to enhance the productivity and efficiency of core industries, such as smart manufacturing, logistics, healthcare, and public services, through AI-based industrial innovation. Second, to realize a data-centric society by strengthening the opening of public and private data and the construction of AI training datasets, while advancing data standardization and management frameworks. Third, to simultaneously expand the industrial ecosystem and research capacity through the cultivation of AI specialized personnel and the establishment of global cooperation networks.

An overview of industrial and technological development status indicates that as of 2023, approximately 1,200 AI-related companies are registered in Korea, with an industry size of approximately 15 trillion KRW. By sector of AI application, the smart manufacturing industry has achieved an approximate 20% improvement in productivity through process optimization and production automation. The logistics industry has significantly enhanced operational efficiency through AI-based demand forecasting and delivery optimization (Ministry of Land, Infrastructure and Transport, Korea, 2025). The healthcare sector has seen improved accessibility and accuracy of medical services via AI solutions, including medical image analysis, patient monitoring, and precision diagnostics. Furthermore, the public sector has seen the practical application of AI-based traffic management,

disaster response robotics, and smart safety systems, contributing to urban operations and enhanced citizen safety (Ministry of Public Administration and Security, Korea, 2025).

Table 23. Status of Korea's AI Industry and Technology (2024)

Sector	Number of Enterprises	Industry Size (Trillion KRW)	Key Achievements
Smart Manufacturing	400	5	20% productivity improvement, process optimization
Healthcare	300	4	Medical image analysis, patient monitoring, precision diagnostics
Logistics	200	3	AI-based demand forecasting, delivery optimization
Public/Safety	300	3	AI traffic management, disaster response, improved citizen safety

Source: Ministry of Science and ICT, Korea (2025), Ministry of Health and Welfare, Korea (2025), Ministry of Land, Infrastructure and Transport, Korea (2025), Ministry of Public Administration and Security, Korea (2025)

Challenges and limitations also persist. Primarily, the absolute shortage of specialized AI personnel is a major constraint on industrial diffusion. Securing core personnel, such as highly skilled data scientists, machine learning engineers, and AI ethics experts, remains difficult. Second, the inadequate regulatory framework concerning personal data protection, security, and ethical issues in data utilization and AI application restricts industrial trust and diffusion speed. Third, the rate of AI technology adoption among SMEs remains low, and the lack of technological standardization and interoperability limits the overall innovation effect across the industry. Furthermore, a gap exists between AI research and commercialization, potentially delaying the global utilization of some leading-edge technologies.

Analyzing the economic implications, AI policy strengthens the competitiveness of core industries like smart manufacturing, healthcare, and logistics, contributing to improved productivity, cost reduction, the creation of high value-added industries, and job expansion. Additionally, AI-based improvements in public services lead to enhanced quality of citizen life, reduced public expenditure, and improved policy efficiency. Critically, within the context of global AI technology competition, Korea's corporate technological capacity and national industrial base possess the potential to secure a competitive advantage in the international market.

In terms of cooperation with ASEAN nations, Korea's AI technology and industrial policy experience can be applied as follows. First, support for the establishment of local industrial ecosystems can be provided through technology transfer and joint projects in smart manufacturing, logistics, and healthcare. Second, contribution to local professional workforce development can be achieved through AI human resource development programs and educational/training cooperation. Third, Korea's experience in data-driven policy formulation and public service innovation can be applied to urban development and administrative efficiency efforts in ASEAN nations. Crucially, amid global supply chain realignment, the complementarity between Korea's AI technology and industrial capacity and ASEAN's emerging markets forms a strategic impetus for concurrently strengthening industrial and technological competitiveness.

In conclusion, Korea's AI technology and industrial policy is developing through an integrated approach encompassing policy design, industrial innovation, human resource development, and global cooperation. Mutual cooperation with ASEAN nations is deemed essential, and the strategic utilization of the AI industry plays a core role in smart innovation collaboration, ensuring that mutually complementary cooperation between Korea and ASEAN is a prerequisite amid global supply chain realignment.

3.2.4. AI and Robotics Industrial Policy and Status

Korea's AI and robotics policies aim to strengthen industrial competitiveness, promote public service innovation, and foster advanced technology development. Through initiatives such as the 'Digital New Deal,' the 'AI National Strategy,' and recent governmental focus on hyper-scale AI, AI semiconductors, and medical AI, AI and robotic technologies are being applied across smart manufacturing, healthcare, logistics, and disaster response sectors.

As of 2023, the sector includes approximately 1,200 AI and robotics-related companies, with the industry size estimated at 15 trillion KRW. The smart manufacturing sector, specifically, has achieved a 20% improvement in productivity through AI-based process optimization and robotic automation (Brunch.co.kr, 2025). Furthermore, medical AI and robotics have been successfully commercialized in practical settings such as patient monitoring, disaster response, and logistics delivery. Notably, the robotics industry, driven by growth in service applications like delivery and disaster response, includes approximately 500 active companies and represents a market size of about 6 trillion KRW as of 2024 (Brunch.co.kr, 2025; IT Donga, 2025).

Table 24. Status of Korea's AI and Robotics Industry (2024)

Sector	Number of Enterprises	Industry Size (trillion KRW)	Key Achievements
Smart Manufacturing	Approx. 400	Approx. 5	20% productivity improvement
Healthcare	Approx. 300	Approx. 4	Medical image analysis, patient monitoring
Robotics	Approx. 500	Approx. 6	Delivery, disaster response

Source: Brunch.co.kr (2025 a. b.), IT Donga (2025)

Limitations within the sector are primarily manifested as a shortage of specialized personnel, inadequate data standardization, and deficiencies in the regulatory framework. Small and medium-sized enterprises (SMEs) face difficulties in adopting AI technology, and the expansion of AI application in public services is constrained by issues of personal data protection and safety concerns. These challenges necessitate concerted efforts toward strengthening technological capabilities, implementing data standardization, and reforming the regulatory system.

Cooperation between Korea and ASEAN nations presents a pathway to strategic synergy in the AI and robotics sector. By linking Korean technology with local industries in smart manufacturing, logistics, and healthcare, mutually complementary collaboration and joint industrial ecosystem development become feasible amid global supply chain restructuring.

3.2.5. Renewable Energy Policy and Status

Korea's renewable energy policy is aligned with the 'Green New Deal 2020,' targeting a 30–35% share of renewable energy generation by 2030. The policy pursues multidimensional objectives, including greenhouse gas reduction, energy independence, the fostering of new renewable energy industries, and job creation. The government implements comprehensive investment and deployment policies across various technologies, such as solar, wind, hydro, and fuel cells. Furthermore, it promotes the deployment of Energy Storage Systems (ESS) and decentralized power grids to secure a stable power supply and maximize the utilization of renewable energy.

As of 2023, the renewable energy share of generation reached 25%, with over 200 energy independence and renewable energy projects being operated, primarily led by enterprises and local governments (Ministry of Trade, Industry and Energy, Korea, 2025). Installed capacity is reported as 12 GW for solar power, 7 GW for wind power, and 3 GW for hydro and fuel cells.

Table 25. Status of Korea's Renewable Energy Generation (2023)

Energy Source	Installed Capacity	Share
Solar Power	Approx. 12 GW	Approx. 12%
Wind Power	Approx. 7 GW	Approx. 7%
Hydro and Fuel Cells	Approx. 3 GW	Approx. 6%

Source: Ministry of Trade, Industry and Energy, Korea (2025 a. b), Korea Hydro & Nuclear Power Co., Ltd. (2025)

Limitations in renewable energy policy stem from issues such as grid integration costs, ESS cost challenges, and local community acceptance. Regional variances in acceptance and challenges in securing power grid stability can restrict policy effectiveness, while technical issues and cost burdens hinder the expansion of private sector participation. Additionally, continuous R&D investment and industrial standardization are necessary for the industrialization of renewable energy technologies.

In terms of economic implications, renewable energy policy plays a vital role in reducing carbon emissions, establishing a new renewable energy industrial ecosystem, creating employment, and securing technological competitiveness. Cooperation with ASEAN nations can facilitate the application of Korea's renewable energy technology and policy experience in countries like Thailand, Vietnam, and the Philippines for expanding new renewable energy generation, optimizing energy efficiency, and executing joint R&D projects, thereby contributing to the achievement of global carbon neutrality goals.

3.2.6. Digital Transformation Policy and Status

Korea's digital transformation policy, linked to the 'Digital New Deal,' promotes ICT, AI, and Big Data-based innovation across public administration, industry, and education. Representative policies include opening public data, establishing digital industrial ecosystems, expanding 5G-based smart industries, and deploying telemedicine, remote education, and remote work systems. These policies have contributed not only to the

COVID-19 response but also to long-term enhancement of industrial competitiveness and the acceleration of economic digitalization.

As of 2023, 5,500 public data sets were opened, and 150,000 digital industry jobs were created. ICT utilization expanded across various applications, including telemedicine, remote work, and remote education. Digital transformation contributes to increased corporate efficiency, improved public services, enhanced educational access, and the establishment of a data-driven policy decision-making framework.

Table 26. Status of Digital Transformation (2023)

Indicator	Value	Note
Open Public Data Sets	5,500	2023
Digital Industry Employment	150,000 people	2023
ICT Utilization	Telemedicine, remote work, education	COVID-19 response

Source: Ministry of Science and ICT, Korea (2024), Ministry of Science and ICT, Korea (2024), Ministry of Science and ICT, Korea (2024)

However, limitations exist in policy implementation. The digitalization pace among small and medium-sized enterprises (SMEs) remains insufficient, and reinforcement of cybersecurity and personal data protection is necessary. Issues regarding data standardization and system interoperability can restrict the effectiveness of digital innovation, posing barriers to AI-based policy utilization and the expansion of industrial digitalization. The economic implications of digital transformation policy include strengthening industrial competitiveness, creating employment, accessing global technology markets, and fostering new industries linked to smart innovation. Cooperation with ASEAN nations offers high potential for applying Korea's digital transformation experience and technology to data-driven policy formulation, the establishment of smart industry and education systems, and innovation in remote healthcare and public services, serving as a core driver for mutually complementary collaboration between Korea and ASEAN amid global supply chain realignment.

3.3. Critical Analysis

Korea's smart innovation policy has evolved over the past two decades into a comprehensive innovation strategy encompassing urban areas, energy, industry, and digital infrastructure, integrating diverse technologies, industries, and policy instruments. This integrated approach has linked individual policy sectors—including smart cities, eco-friendly mobility (EV), AI/Robotics, renewable energy, and digital transformation—and contributed to generating outcomes directly tied to industrial and economic development. However, a deep critical analysis reveals that certain limitations and areas for improvement still exist regarding policy integration and effectiveness, industrial and technological capacity, and international cooperation experience.

3.3.1. Analysis of Policy Integration and Outcomes

Korea's smart innovation policy was designed to generate synergistic effects between policy sectors. The linkage between smart city and EV policies simultaneously aimed for urban traffic efficiency and the development of eco-friendly vehicle infrastructure. AI/Robotics technology was applied across smart manufacturing, healthcare, and public services to enhance urban efficiency and industrial productivity. Furthermore, the convergence of renewable energy and EV policies strengthened the eco-friendly industrial ecosystem, while digital transformation and smart city policies improved data-driven administrative efficiency.

However, several limitations are evident concerning policy integration. First, a significant policy effectiveness gap persists between small/medium-sized provincial cities and metropolitan areas. The design of smart city data platforms, EV charging station deployment, and digital industrial infrastructure is concentrated in major cities, restricting the benefits of technology utilization and industrial development in provincial regions. Second, in the AI/Robotics and renewable energy sectors, policy execution tends to focus on individual technology projects rather than comprehensive industrial linkage, resulting in insufficient systematic integration across the entire industry. Third, the governance structure involving private enterprises, academia, and citizen participation during policy implementation is somewhat limited, constraining policy acceptance and the speed of diffusion.

In terms of economic outcomes, Korea's smart innovation policy has demonstrated substantial positive effects. Congestion reduction and energy savings through smart city policies, carbon emission reduction via EV adoption

and renewable energy expansion, improved smart manufacturing productivity from the AI/Robotics industry, and job creation in the digital industry have all provided direct and indirect contributions to the national economy. These achievements serve as a vital foundation for transferring policy experience and technical know-how in cooperation with ASEAN nations.

3.3.2. Evaluation of Industrial and Technological Capacity

Korea's industrial and technological capacity is a core factor directly linked to the performance of its smart innovation policies. The EV industry possesses world-class competitiveness in batteries, charging infrastructure, and EV manufacturing technology. The AI/Robotics sector has formed an industrial ecosystem centred on smart manufacturing, healthcare, logistics, and public services. The renewable energy sector has accumulated efficient power grid management capacity through diverse technologies, including solar, wind, hydro/fuel cells, and ESS (Energy Storage Systems). The digital transformation sector has secured systematic capabilities across the entire digital industry, including public data opening, expansion of 5G-based smart industries, and AI/Big Data-driven policy determination.

However, the evaluation of industrial and technological capacity points to the following limitations. First, the shortage of specialized personnel in the AI/Robotics and digital industries persists, with the pace of human resource development failing to keep up with the speed of technological advancement. Second, the inadequate technological standardization and regulatory frameworks in some industrial sectors restrict efficient diffusion across the industry. Third, the digital transformation and technology utilization capabilities of local small and medium-sized enterprises (SMEs) are significantly lower compared to large corporations and metropolitan areas, leading to a regional disparity in industrial competitiveness. These limitations must be considered in the cooperation process with ASEAN nations, necessitating mutually complementary cooperation through technology transfer and human resource development programs.

In terms of economic implications, smart innovation policy, supported by enhanced industrial and technological capacity, yields multi-faceted benefits, including the creation of new industrial ecosystems, improved industrial productivity, the creation of new employment, and the securing of global market competitiveness. Crucially, amid

global supply chain realignment, cooperation between Korea and ASEAN nations in advanced industrial sectors is essential for securing mutually complementary industrial competitiveness and integrating global value chains.

Chapter 4. Korea-Asean Comparative Analysis and Cooperation Strategies

Introduction: The Korea-ASEAN Relationship as a Nexus of Global Smart Innovation

The 21st century has seen digital transformation and the green transition emerge as core pillars of global economic development. The confluence of these two innovations has formed a new paradigm: smart innovation, which is understood as a comprehensive concept involving structural changes across technology, industry, administration, and society. In this context, despite their diverse economic and policy backgrounds, Korea and ASEAN exhibit mutually complementary development trajectories and are assessed as regional partners with exceptionally high potential for cooperation.

Korea, having secured policy consistency and technological self-reliance through industrialization and democratization, has built an integrated smart innovation ecosystem through policies such as the Digital New Deal, Green New Deal, AI Strategy, and the K-Smart Industrial Complex Policy. ASEAN, conversely, features significant disparity in development stages among its member states. Nevertheless, it is emerging as an "emerging region of opportunity" underpinned by rapidly increasing urbanization and technology demand, a young demographic structure, and a dynamic manufacturing base.

Cooperation between ASEAN and Korea must evolve beyond simple technology export-import relationships and into a "co-innovation" model based on the synchronized linkage of policy, industry, human resources, and technology. Particularly amid the deepening U.S.-China technology rivalry and global supply chain realignment, Korea and ASEAN share a strategic common interest in three aspects: supply chain diversification, mutual linkage of the digital economy, and the joint pursuit of green growth.

4.1. Comparative Analysis of Korea and ASEAN Smart Innovation Policies

At the turning point of 21st-century digital and green transitions, Korea and ASEAN have pursued smart innovation policies based on distinct historical, institutional, and technological foundations. Korea rapidly transitioned to a technology-intensive industrial structure following the late 1990s financial crisis by adopting a knowledge-based economy strategy. In contrast, the diversity of development stages within ASEAN has resulted in varied policy momentum and outcomes across member states. These differences are evident in industrial structure, governmental policy capacity, private sector innovation ecosystems, and international cooperation frameworks.

Korea's smart innovation policy is designed for the organic integration of data, AI, robotics, smart manufacturing, EVs, and renewable energy, centred on the 'Digital New Deal (2020)' and the 'K-Smart Industrial Strategy (2022)'. Conversely, ASEAN nations predominantly exhibit sectoral policy design. For example, while Thailand pursues "Thailand 4.0," Malaysia pursues "My Digital Blueprint," and Vietnam pursues the "National Digital Transformation Program 2025," policy linkage among sectors is relatively weak.

This difference creates a significant gap in the degree of Policy Integration and Technology Spillover within industries. Korea has already built an industrial ecosystem where AI, robotics, energy, and mobility operate complementarily. In contrast, ASEAN's reliance on disparate, agency-led sectoral policies often leads to a lack of governance consistency.

Table 27. Comparative Analysis of Smart Innovation Policies between Korea and ASEAN

Category	Korea	ASEAN (Average Characteristics)
Policy Integration	Integrated roadmap and linkage between sectors (e.g., K-Smart Industrial Strategy)	Fragmented sectoral approach; country-specific and varying implementation frameworks
Technological Capacity	World Top 10 level in AI, Semiconductor, and Mobility technology	Focused on ICT/Digital Services; weaker in core manufacturing technology
Financial and Institutional Support	Government subsidies, tax incentives, national R&D funds	Resource structure focused on international aid and foreign investment

Public-Private Cooperation Structure	Triple-helix cooperation system among Large Corporations–Startups–Government	Primarily public-institution driven; limited participation from private innovation
Human Resource Development	AI graduate schools, smart industry talent development strategy	Vocational training focused; advanced technology talent development in early stages

Source: Ministry of Trade, Industry and Energy, Korea (2023); ASEAN Secretariat (2024); OECD Science & Innovation Outlook (2023).

Given these structural differences, Korea-ASEAN cooperation must transition beyond simple technology transfer or aid models to become a mutually complementary innovation partnership model. For instance, Korea can provide high-level technology and standardization capabilities, while ASEAN contributes its foundation of human resources, market access, and data resources. This combined effort can establish a Co-Growth Innovation Regime.

4.1.1. Comparison of Policy Stance and Institutional Foundation

While both Korea and ASEAN perceive smart innovation as a core driver for enhancing national competitiveness, their policy design and implementation frameworks exhibit distinct characteristics. Korea employs a centralized, integrated policy framework led by the central government, simultaneously driving technological and industrial innovation. In contrast, ASEAN utilizes a decentralized approach tailored to individual member states, thereby forming a multi-layered cooperation structure.

Korea's policy framework is characterized by the organic linkage of specific policies, such as the 'National AI Strategy' and the 'K-Smart Industrial Complex Policy,' around large-scale national transformation initiatives like the 'Digital New Deal' and the 'Green New Deal.' This centralized integration and coordination system maximizes policy consistency and efficiency through the collaboration of key ministries, including the Ministry of Science and ICT, the Ministry of Trade, Industry and Energy, and the Ministry of Environment. Furthermore, Korea has built an industrial ecosystem utilizing 5G, AI, and Cloud technologies atop a highly advanced industrial base encompassing high-tech manufacturing, semiconductors, ICT services, and AI platforms. Korea's policy model is

oriented toward the 'triple helix model,' involving close cooperation among the government, industry, and research institutions (Ministry of Science and ICT, Korea, 2024).

Conversely, ASEAN's policies follow a decentralized structure, where individual member states formulate independent frameworks based on their respective stages of development and needs. While regional initiatives such as the ASEAN Smart Cities Network (ASCN) and the ASEAN Digital Masterplan 2025 exist, they lack the enforcement mechanism for rigorous integration of individual member policies. Policy execution frameworks consequently vary across nations, with Singapore taking a leading role, closely followed by Vietnam and Malaysia. ASEAN's industrial base is centred on labor-intensive manufacturing, services, agriculture, and tourism, and its technological infrastructure remains primarily based on 4G networks. Financial resource mobilization heavily relies on external sources, such as international aid and Foreign Direct Investment (FDI). These characteristics compel ASEAN to pursue policies centred on multilateral cooperation and Public-Private Partnerships (PPP).

Table 28. Comparison of Korea and ASEAN Smart Innovation Policy Stance and Institutional Foundation

Category	Korea	ASEAN (Common and Average of Key States)
Policy Framework	'Digital New Deal,' 'Green New Deal,' 'National AI Strategy,' 'K-Smart Industrial Complex Policy,' etc.	'ASEAN Smart Cities Network (ASCN),' 'ASEAN Digital Masterplan 2025,' etc.
Implementation System	Centralized Integrated Coordination (Ministries of Science and ICT, MOTIE, Environment, etc.)	Decentralized and country-specific (Singapore leads, Vietnam/Malaysia follow)
Industrial Base	High-tech manufacturing, Semiconductors, ICT Services, AI Platforms	Labor-intensive manufacturing, Services, Agriculture, Tourism-centric
Technological Infrastructure	5G, AI, Cloud-based industrial ecosystem	4G-centric, focused on technology adoption and external capital inflow
Key Policy Characteristics	Triple-helix model (Government-Industry-Research Institutions)	Multilateral cooperation and Public-Private Partnership (PPP)-centric

Source: Ministry of Science and ICT, Korea (2024); ASEAN Secretariat (2023).

While Korea's centralized integrated system effectively secures efficiency, its development model, centred on large corporations, still harbors structural issues such as inter-industry imbalance and limited technological accessibility for small and medium-sized enterprises (SMEs). Conversely, although ASEAN's decentralized system compromises policy consistency, it possesses the flexibility to pursue diverse experimental innovation policies based on the unique regional characteristics and resources of each member state. This inherent flexibility presents a potential for establishing a 'regionally tailored' smart innovation model—a challenge that Korea has yet to fully resolve.

4.1.2. Comparison of Smart City Policies

Smart cities represent the most actively pursued joint innovation sector for both Korea and ASEAN. Korea's smart city model has advanced around data integrated platforms and AI-based urban management systems. Pilot projects, such as Busan Eco Delta City and Sejong Smart City, are already recognized as international best practices. Korea's policy strongly advocates for an 'integrated platform' model that simultaneously optimizes efficiency across various sectors—including transportation, energy, environment, and safety—by integrating all urban data.

ASEAN's smart city policies are generally in the infrastructure-centric development phase, primarily aiming to enhance administrative efficiency rather than comprehensive ICT integration. Excluding leading nations like Singapore, most cities tend to execute projects focused on individual sectors such as transportation, security, and sanitation. Nevertheless, ASEAN's Public-Private Partnership (PPP) structure proves effective in dispersing long-term financial burden and enhancing sustainability. For instance, smart city projects in Thailand and Vietnam exhibit a heavy reliance on investment and technology from foreign enterprises, such as Grab, Huawei, and Siemens.

Table 29. Comparison of Korea and ASEAN Smart City Policies

Item	Korea	ASEAN Key States (Singapore, Malaysia, Thailand, etc.)
Urban Operating System	Integrated Platform-based (Real-time integration of CCTV/sensor data)	Sector-specific focus (Transportation, Security, Sanitation, etc.)

Budget Scale	Over 1 trillion KRW (e.g., Busan Eco Delta case)	50 million to 300 million USD scale
Citizen Participation	Living Lab/Citizen Council focused	Public service demand-driven participation
Technology Partners	Domestic enterprises focused (e.g., Samsung SDS, LG CNS, KT)	Foreign capital focused (e.g., Grab, Huawei, Siemens)

Source: Ministry of Land, Infrastructure and Transport, Korea (2024); ASEAN Smart Cities Network (2023).

Critically, the Korean model, being technology-centric, may not fully incorporate local socio-cultural factors, while the ASEAN model faces limitations in technological adoption imbalance and a shortage of operational personnel. Future cooperation between the two regions must aim for a mutually complementary integration of technology and institutions. This can materialize as combining Korea's integrated platform technology with ASEAN's PPP model to deliver customized solutions tailored to regional characteristics.

4.1.3. Comparison of EV and Smart Mobility Policies

Korea's electric vehicle (EV) policy is highly advanced, based on a triple-helix structure of battery-vehicle-charging infrastructure. It leads the global market in both battery technology and finished vehicle production. Korea maintains a core position in the global supply chain, housing world-class battery manufacturers such as LG, Samsung, and SK.

Conversely, ASEAN is fostering its EV industry as part of a strategy for industrial diversification and attracting Foreign Direct Investment (FDI). The ambitious EV deployment target is 20 million units by 2035, representing approximately 20% of the total vehicle fleet. ASEAN possesses abundant mineral resources essential for battery production, such as nickel and cobalt. Particularly, Indonesia and Thailand are pursuing strategies to emerge as global EV production hubs based on these resources. However, their technological capacity remains lower than that of Korea, China, or Japan.

Table 30. Comparison of Korea and ASEAN EV and Smart Mobility Policies

Item	Korea	ASEAN
EV Deployment Target	4.5 million units by 2030	20 million units by 2035 (20% of total fleet)

Battery Industry	Led by the "Big Three" global supply chain (LG, Samsung, SK)	Nickel-based production centred in Indonesia/Thailand
Policy Support	Tax reduction, Charging Infrastructure, Export Finance	Focused on attracting FDI, localization of components
Technology Cooperation	Joint research with EU/US	Dependence on external capital and cooperation with Korea/China/Japan

Source: Ministry of Trade, Industry and Energy Korea (2024); ASEAN Center for Energy (2023).

Korea's EV industry is built upon a high value-added manufacturing base but faces risks associated with market saturation and potential conflicts over technological standardization. While ASEAN has less technological capability, its possession of critical mineral resources (nickel, cobalt, etc.) positions it to emerge as a core hub in the battery supply chain. Consequently, a cooperation structure based on "K-Battery Technology + ASEAN Resources" can create mutually complementary competitiveness in the global market. This model enables the formation of a new value chain encompassing the entire EV supply chain by combining Korea's advanced battery technology with ASEAN's abundant resources.

4.1.4. Comparison of AI and Robotics Industries

The AI sector represents the area with the most distinct technological gap between the two regions. As of 2024, Korea allocates approximately 6% of its national R&D budget to AI-related projects, leading the commercialization of AI semiconductors, medical AI, autonomous driving, and smart factory solutions. Public-private cooperation for the development of hyper-scale AI technology is particularly active.

Conversely, ASEAN's focus, limited by shortages in human resources and data infrastructure, remains centred on fundamental applications such as administrative efficiency, agriculture, and education, rather than complex AI utilization. Excluding Singapore, most countries are in the initial stages of AI technology adoption and exhibit a high reliance on foreign technology.

Table 31. Comparison of Korea and ASEAN AI and Robotics Industries

Item	Korea	ASEAN
R&D Investment Scale	2.5 trillion KRW annually	Approx. 400 million USD (ASEAN total)
Key Application Sectors	Manufacturing, Healthcare, Public Safety	Administration, Agriculture, Education

AI Human Resource Development	Over 5,000 personnel annually (AI Graduate Schools, specialized talent strategy)	Uneven: Singapore-centric, limited development elsewhere
Major Constraints	Limited diffusion among SMEs, inadequate ethical regulations	Shortage of technological capability/infrastructure, lack of data standardization

Source: Ministry of Science and ICT Korea (2024); World Bank (2023).

Cooperation in this sector must evolve beyond simple technology transfer to include joint AI research and the establishment of data-sharing platforms. Notably, since 2023, Vietnam and Korea have been discussing the joint establishment of an AI research centre, which could serve as a crucial precedent for diffusion across the ASEAN region. Korea can share its experience in AI technology development and talent cultivation, while ASEAN can contribute local data and market access, ensuring mutual benefit.

4.1.5. Comparison of Renewable Energy and Green Policies

Responding to the climate crisis and pursuing energy transition are common challenges for both Korea and ASEAN. Korea is currently restructuring its entire industrial system under the 'Carbon Neutrality 2050 Roadmap,' advocating for a technology-intensive renewable energy model focusing on offshore wind and solar power.

ASEAN aims for the simultaneous expansion of energy access and low-carbon transition. While leveraging abundant hydro and biomass resources for renewable energy expansion, the region faces significant institutional and technological constraints. Specifically, grid integration and the development of Energy Storage Systems (ESS) remain major challenges.

Table 32. Comparison of Korea and ASEAN Renewable Energy and Green Policies

Item	Korea	ASEAN
Renewable Energy Share (2023)	9.3%	Average 14% (High national variation)
Primary Energy Sources	Solar, Offshore Wind	Hydropower, Biomass
Investment Scale	12 trillion KRW annually	Approx. 2 billion USD annually
Institutional Support	Carbon Tax, Green Finance	Relies on International Organizations/ODA

Source: Ministry of Trade, Industry and Energy, Korea (2024); ASEAN Center for Energy (2024).

While Korea pursues a technology-intensive energy transition model, its diffusion pace is restricted by land constraints and issues of local acceptance. Conversely, ASEAN can utilize its rich natural resources but faces many institutional and technological barriers. Therefore, the two regions can concurrently strengthen energy security and sustainability through a technology-resource combined cooperation model. For example, a joint project combining Korea's ESS and smart grid technology with ASEAN's abundant hydro and solar resources can generate powerful synergy.

4.2. Necessity of Cooperation Amidst Global Supply Chain Realignment

The trend of globalization since the early 21st century is being rapidly restructured due to recent events such as the US-China strategic rivalry and the COVID-19 pandemic. The Global Supply Chain, previously designed for maximum efficiency and low cost, is now shifting toward a new paradigm centred on stability, resilience, and strategic autonomy. This structural change is more than a simple shift in trade patterns; it represents a massive geopolitical realignment where technological hegemony, national security, and industrial policy are intricately interwoven.

Amid this massive structural wave, cooperation between Korea and ASEAN has become not merely an option but an imperative. Korea has established itself as a global technology leader, pioneering high value-added core industries such as semiconductors, EV batteries, AI, and advanced robotics. ASEAN, with its young population (680 million), dynamic manufacturing base, and abundant mineral resources, has emerged as a core production hub and a rapidly growing digital market, central to the "China+1" strategy. Therefore, within the regionalization trend of global supply chains, Korea-ASEAN cooperation is highly regarded as a strategic pillar for the mutually complementary linkage of technology and production value chains.

Indeed, the Korean government's 'K-Supply Chain 3.0' strategy, announced in 2023, is predicated on this change, aiming for stable sourcing of core materials/components and supply chain diversification. The designation of ASEAN as a core partner in this strategy reflects Korea's strong policy commitment to forming a mutually interdependent network of technology and resources, transcending simple economic exchange (Ministry of Trade, Industry and Energy, Korea, 2024).

4.2.1 Structural Changes in Global Supply Chain Realignment and the Imperative for Korea-ASEAN Cooperation

The realignment of global supply chains is triggered by three major factors, all of which intensify the necessity of Korea-ASEAN cooperation.

Deepening US-China Technology Hegemony Competition

The U.S. is restructuring its semiconductor industry and green industry supply chains around itself and its allies through legislation like the 'CHIPS and Science Act' (2022) and the 'Inflation Reduction Act' (IRA, 2022). This has resulted in a bifurcation of the global industrial ecosystem. In response, China is pursuing technological self-reliance and global influence expansion through its 'Made in China 2025' strategy and the 'Digital Silk Road.'

Amid this geopolitical conflict, Korea is being redefined as a core partner in the U.S.-centric supply chain for advanced technology (semiconductors, batteries, AI). Simultaneously, ASEAN's role is being redefined as an alternative production base centred on manufacturing, mineral resources, and logistics. Notably, Korea's Foreign Direct Investment (FDI) into ASEAN has surged since 2020, reaching 14.8 billion USD by 2023, accounting for approximately 20% of its total overseas investment (KOTRA, 2024). This is interpreted as a strategic move by Korea to manage geopolitical risks by diversifying its supply chains in the semiconductor, battery, and AI sectors to the ASEAN region, while strengthening its regional production base. ASEAN plays the role of a "strategic balancer" amidst the US-China competition, providing a stable business environment for both nations.

The Rising Importance of Supply Chain Resilience Post-COVID-19 Pandemic

The COVID-19 pandemic clearly exposed the vulnerabilities inherent in global supply chains (GSCs). Global logistics bottlenecks due to border closures, disruptions in semiconductor supply-demand balance, and crises in food and energy security compelled governments and corporations worldwide to recognize supply chain resilience as a top priority. Consequently, nations began pursuing strategies focused on risk diversification within GSCs and strengthening domestic-centric production bases through reshoring or nearshoring initiatives. This trend has become a critical catalyst accelerating the relocation of manufacturing facilities by Korean firms into the Southeast Asian region.

ASEAN, in response, adopted the 'ASEAN Comprehensive Recovery Framework (ACRF)' in 2022. The ACRF established the strengthening of supply chain resilience and the promotion of digital linkages within the region as core agenda items, aiming for economic recovery and GSC restoration post-pandemic. This framework acts as a complement to Korea's 'K-Supply Chain 3.0' strategy, providing a basis for strengthening policy complementarity between the two entities. Such policy cooperation is poised to evolve beyond simple technology exchange, leading to the establishment of co-governance to jointly respond to crises and secure future growth engines.

Industrial Transition Centred on Carbon Neutrality and Sustainability

The pursuit of the Carbon Neutrality 2050 goal and the widespread adoption of ESG (Environmental, Social, and Governance) principles are transitioning efficiency-focused traditional GSCs into eco-friendly and ethical supply chains. This shift represents both a new burden and a significant opportunity for the industrial sector. Korea is actively fostering advanced eco-friendly technologies, including hydrogen, solar power, and Energy Storage Systems (ESS), through its Green New Deal policies. Conversely, ASEAN possesses abundant natural resources and vast renewable energy potential.

In this context, establishing new cooperation frameworks between Korea and ASEAN in green energy, EVs, recycling of raw materials, and eco-friendly logistics systems is essential. For instance, cooperation that combines Korea's ESS technology with Indonesia's rich nickel resources to optimize eco-friendly battery production not only maximizes the strengths of both nations but also offers a new GSC model compliant with global ESG standards. This change underscores that the GSC is no longer merely an economic efficiency issue but a complex system integrating politics, technology, and environment. Therefore, Korea-ASEAN cooperation must evolve beyond industrial collaboration toward establishing supply chain co-governance.

4.2.2. Korea's Supply Chain Strategy and ASEAN's Role

In 2023, Korea announced the 'K-Supply Chain 3.0' strategy, positioning supply chain stability as a core national security and economic task. This strategy is structured around three main pillars: first, achieving Localization of core materials, components, and equipment to reduce external dependency; second, establishing an Early Warning System to monitor supply chain risks in real-time; and third, pursuing Diversification of international cooperation to reduce reliance on specific countries (Ministry of Trade, Industry and Energy, Korea, 2024). The

essence of this strategy lies in building a hybrid supply chain structure that integrates technological innovation with global cooperation.

Within this strategic trajectory, ASEAN is being redefined not merely as an assembly base or a low-cost production centre but as a strategic partner and co-production hub vital for securing Korea's supply chain stability. Korea is leveraging ASEAN to disperse geopolitical risk and is establishing new value chains that combine its advanced technology with ASEAN's abundant resources and infrastructure.

Specific Examples of Core Industrial Cooperation between Korea and ASEAN Nations

EV and Battery Supply Chain Cooperation

Indonesia holds a strategic position in the global EV supply chain as the world's largest nickel producer, possessing approximately 21% of global nickel reserves (United States Geological Survey, 2024). Nickel is a core raw material for EV batteries, and Korea is capitalizing on this advantage by pursuing large-scale battery and EV industrial cooperation with Indonesia.

- LG Energy Solution and Hyundai Motor Group established a large-scale battery cell joint venture plant in Indonesia's Karawang Industrial Estate. This represents a prime example of combining Korea's advanced battery manufacturing technology with Indonesia's rich nickel resources. This plant is capable of producing 10 GWh of battery cells annually, enough to supply approximately 150,000 electric vehicles (LG Energy Solution, 2024).
- This collaboration extends beyond simple investment attraction; it contributes to building a vertical EV supply chain in Indonesia, encompassing 'mineral mining—battery production—finished vehicle assembly—charging infrastructure development.' This secures stable battery raw material sourcing for Korean companies while giving them a strong foothold in the ASEAN market.

Semiconductor and Electronic Component Supply Chain Cooperation

The semiconductor industry is central to global technology hegemony competition. Korea leads the world in memory semiconductor and AI semiconductor design technology, while ASEAN plays a critical role in the OSAT (Outsourced Semiconductor Assembly and Test) segment.

- Malaysia is a major hub, accounting for 13% of the global OSAT market (Malaysia Investment Development Authority, 2024). Penang, in particular, is dubbed the 'Silicon Valley of Southeast Asia,' where global semiconductor companies are concentrated. Korean companies like Samsung Electronics and SK Hynix are utilizing Malaysia's OSAT capacity to diversify the back-end production processes.
- Vietnam is a major hub for electronic component production. Samsung Electronics has established smartphone and electronics manufacturing bases in Vietnam, strengthening its component supply chain through collaboration with local firms. This represents a strategy to complete the 'front-end—back-end' value chain by combining Korea's advanced semiconductor technology with Vietnam's skilled assembly expertise.

AI and Robotics Industrial Cooperation

Korea possesses world-class competitiveness in AI semiconductor design, hyper-scale AI model development, and AI-based smart manufacturing and service robotics. Conversely, ASEAN has high demand for applying AI technology to its industries and boasts a young, dynamic workforce.

- Vietnam and Korea are enhancing cooperation in AI human resource development and technology R&D, including discussions on establishing a joint AI research centre. This collaboration aims to create new business models by combining Korea's AI technological expertise with Vietnam's software development capabilities.
- Thailand's smart manufacturing industry is enhancing its productivity through the adoption of Korea's AI-based smart factory solutions. This demonstrates a mutually complementary relationship that concurrently strengthens industrial competitiveness by integrating Korea's advanced technology with Thailand's manufacturing base.

In conclusion, ASEAN offers production efficiency, abundant human resources, core resources, and geopolitical accessibility to Korea's advanced technology-centric supply chain, thus forming a mutually complementary relationship. This cooperation is a core driver for both nations to disperse geopolitical risk and create new value within the global supply chain.

4.2.3. ASEAN's Strategy for Enhancing Supply Chain Resilience

ASEAN recognizes the importance of global supply chain realignment and is actively pursuing policies to strengthen the stability and resilience of its intra-regional supply chains. These policies focus not merely on economic recovery but on building a self-reliant economic structure that is resistant to external shocks in the long term.

The most representative initiative is the 'ASEAN Comprehensive Recovery Framework (ACRF)' adopted in 2022. This framework aims for post-pandemic economic recovery and GSC restoration, setting the strengthening of intra-regional transport, logistics, and digital connectivity as core agenda items. The ACRF focuses on facilitating the movement of goods and services among member states and accelerating the digitalization of cross-border trade to resolve logistics bottlenecks. Concurrently, the 'ASEAN Smart Logistics Vision' announced in 2023 emphasizes utilizing AI and IoT technologies for logistics optimization, port automation, and establishing data-driven trade platforms. This demonstrates ASEAN's commitment to evolving beyond a mere production base into a technology-driven smart logistics hub.

ASEAN's supply chain strengthening strategy is characterized by three key features:

- **Enhancing Logistics Efficiency through Intra-Regional Digital Integration:** ASEAN is utilizing the 'ASEAN Single Window' system to digitize customs procedures among member states and integrate logistics data, enhancing trade efficiency. This system contributes to reducing logistics costs by creating a paperless trade environment and shortening document processing time.
- **Industrial Diversification and Specialized Intra-Regional Production:** ASEAN member states are promoting a 'Regional Value Chain' that leverages the strengths of each country. For instance, Vietnam specializes in electronic component assembly and software development, Thailand in automotive and parts manufacturing, and Indonesia in battery production utilizing mineral resources. This specialization

enhances intra-regional industrial division, reducing reliance on single nations during external shocks and increasing GSC flexibility.

- Expansion of Advanced Manufacturing Infrastructure through Foreign Direct Investment (FDI) Attraction: ASEAN actively attracts global corporate investment through stable political environments and favorable investment policies. Specifically, it offers tax incentives, infrastructure support, and human resource development programs to firms pursuing the 'China+1' strategy, successfully attracting investment in advanced sectors like EVs, semiconductors, and AI from technological powerhouses including Korea, China, and Japan.

This ASEAN strategy is structurally complementary to Korea's technology-innovation-centric GSC strategy. While Korea holds strengths in the upstream value chain (technology and R&D), ASEAN manages the downstream value chain (production, logistics, and resources). This division enables functional specialization within the supply chain, facilitating a cooperation model that extends beyond mere economic benefit to strategic partnership, allowing both nations to jointly address geopolitical risk and GSC uncertainties.

4.2.4. Analysis of Korea–ASEAN Mutually Complementary Industrial Structure

Amidst global supply chain realignment, Korea and ASEAN are evolving into strategic partners that generate synergy by combining their respective strengths, moving beyond a simple economic partnership. The table below summarizes the mutually complementary industrial structures formed by the two regions.

Table 33. Korea–ASEAN Mutually Complementary Structure in Global Supply Chain Realignment

Industrial Sector	Korea's Strength	ASEAN's Strength	Form of Cooperation
Semiconductor	Design, Process, and Manufacturing Technology	Assembly, Test, and Packaging Infrastructure	Joint Production Cluster Establishment
Battery (EV)	Cathode/Anode Materials, Manufacturing Technology	Mineral Resources (Nickel, Lithium, Cobalt)	Supply Chain Integration and Technology Transfer
AI and Robotics	Algorithms, Hardware Technology	Data Resources, Application Industries	Joint AI Application Research

Smart City	Infrastructure Integration Technology	Population and Urban Growth Base	Joint Smart City Development
Renewable Energy	Hydrogen, Solar Technology	Wind, Hydro, Biomass Potential	Joint Carbon Reduction Projects

Source: Ministry of Trade, Industry and Energy, Korea (2024); ASEAN Secretariat (2024); UN ESCAP (2023).

This table clearly illustrates the structural complementarity of Korea–ASEAN cooperation.

- **Semiconductor:** The combination of Korea's design/manufacturing technology and ASEAN's assembly/test capacity can concurrently secure global supply chain cost reduction and stability.
- **Battery:** The combination of Korea's advanced technology and ASEAN's rich mineral resources enables the establishment of a vertical integration supply chain, spanning from raw materials through components (cells/modules) to finished vehicles.
- **AI and Robotics:** Combining Korea's technological capacity with ASEAN's data resources and application markets facilitates the development of localized AI solutions.
- **Smart City and Renewable Energy:** These areas are well-suited for establishing ESG-centric cooperation models. Integrating Korea's technology with ASEAN's population and urban growth base can foster sustainable urban ecosystems.

Advanced Analysis of Cooperation Potential by Major Industrial Sector is as follows:

Semiconductor Industrial Cooperation: 'Technology-Production' Value Chain Integration

The semiconductor industry stands as the core of the modern digital economy and the nexus of geopolitical competition. Korea holds a dominant position in the global market, accounting for approximately 60% of the market share in memory semiconductors (Samsung Electronics, SK Hynix) and possesses highly advanced process technology and extensive Research and Development (R&D) capabilities. Korea's expertise is unparalleled in the front-end production processes, including wafer fabrication and circuit design. Conversely, ASEAN has secured world-class competitiveness in the semiconductor back-end processes: Outsourced Semiconductor Assembly and Test (OSAT). A report by PwC (2024) indicates that ASEAN is emerging as a critical anchor in the global

OSAT market, signaling the potential for immense synergy when combined with Korea's advanced technology and ASEAN's production infrastructure.

Malaysia serves as a core hub for this cooperation. The Penang region is often referred to as the 'Silicon Valley of Southeast Asia,' boasting a concentration of global semiconductor firms such as Intel, AMD, and ASE in the back-end processing sector. This region offers a stable investment environment, superior logistics infrastructure, and a skilled technical workforce, establishing high potential for technological cooperation with Korea.

Joint Production Cluster Establishment

Korea and Malaysia can introduce a novel supply chain model based on 'technological specialization and production coupling' by establishing a joint semiconductor test and packaging cluster. This strategic approach integrates Korea's advanced front-end technology with Malaysia's efficient back-end infrastructure, simultaneously achieving two critical objectives: enhancing semiconductor supply chain stability and reducing production costs (World Bank, 2024). This model moves beyond simple Original Equipment Manufacturer (OEM) relationships, creating a structure where both nations play essential roles at core stages of the semiconductor value chain.

Specific cooperation measures include:

- **Technology Transfer and Joint R&D:** Korean semiconductor companies can share know-how related to next-generation packaging technologies (e.g., heterogeneous integration) with Malaysian partners. The establishment of joint R&D centres can bolster technological competitiveness.
- **Human Resource Development Programs:** In collaboration with the Malaysian government and local universities, specialized training programs for back-end semiconductor expertise can be implemented. This secures a stable pool of technical talent, facilitates smooth local operations for Korean companies, and concurrently elevates Malaysia's industrial capacity.
- **Standardization and Governance Establishment:** Both governments and industry stakeholders must jointly establish technical standards for back-end processes and create a governance system to enhance

transparency and reliability within the supply chain, thereby securing a competitive edge in the global market.

Strengthening Policy Support and Investment

The Korean government's 'K-Supply Chain 3.0' strategy provides robust support for this cooperation model. The strategy promotes investment by Korean companies in the ASEAN region, including Malaysia, through enhanced financial and administrative support for back-end semiconductor investment, such as investment subsidies, tax incentives, and infrastructure development assistance. Furthermore, both nations regularly host the 'Korea-Malaysia Semiconductor Forum' to maintain institutional foundations for cooperation through policy consultations. The synergy resulting from policy support combined with private sector investment is expected to transcend mere supply chain diversification, transforming both regions into core partners within the global semiconductor ecosystem. This strengthens joint response capabilities against global supply chain uncertainties and contributes to the long-term economic security and technological development of both nations.

EV and Battery Industrial Cooperation: 'Resource-Technology' Combined Supply Chain Establishment

The electric vehicle and battery industries are core drivers of smart innovation and stand at the forefront of global supply chain realignment. Cooperation between Korea and ASEAN in this sector focuses on establishing a mutually complementary vertical integration supply chain, strategically combining technology and resources. This cooperation model is emerging as an indispensable element for the sustainable growth of both regions.

Indonesia holds a prominent strategic position in the global EV battery supply chain, being a key resource nation for nickel and cobalt, essential raw materials for EV battery production. According to the United States Geological Survey (2024), Indonesia possesses 22% of the world's nickel reserves and 5% of its cobalt reserves. Conversely, Korea, with industry leaders such as LG Energy Solution, Samsung SDI, and SK On, possesses world-class battery manufacturing technology. This 'resource-technology' combined cooperation structure facilitates the regionalization of the global supply chain and serves as an effective strategy to reduce dependency on specific nations.

Vertical Integration Value Chain Establishment

The Indonesian government is determined to leverage its abundant mineral resources to transform the nation into a global hub for the EV industry. To achieve this, large-scale joint venture projects involving Korean companies are underway in the Morowali Industrial Park (MIW). LG Energy Solution and Hyundai Motor Group have invested approximately 1.5 trillion KRW in the area to establish a joint battery cell manufacturing plant. This facility is designed to produce 10 GWh of battery cells annually, capable of supplying about 150,000 EVs. This cooperation model realizes a complete vertical integration value chain, encompassing the mining of nickel, its local processing into cathode materials, and the final production of battery cells and packs. BloombergNEF (2024) suggests that this vertical integration maximizes supply chain stability while minimizing uncertainties in raw material sourcing due to price volatility or geopolitical risks.

Growth as an EV Production Hub

Beyond Indonesia, nations such as Vietnam and Thailand are rapidly emerging as EV production hubs. Korea's Hyundai Motor Group has already established a finished vehicle manufacturing plant in Indonesia, securing a bridgehead for accessing the ASEAN market. This facility, supplied with battery cells from LG Energy Solution, exemplifies a joint ecosystem for EV production. In Vietnam, local automotive companies, such as VinFast, are utilizing Korean battery technology to develop EV models, indicating active technological collaboration.

This cooperation enables Korean companies to secure a dominant position in ASEAN's growing domestic markets while expanding into new business opportunities, including charging infrastructure deployment and battery recycling operations. Notably, the Thai government is actively promoting the EV industry through its '30@30' policy (targeting 30% of total automotive production to be EVs by 2030) and is strategically pursuing technology collaboration and investment attraction from Korean companies to elevate its overall EV ecosystem. Through the stable combination of technology and resources, Korea can solidify its competitive edge in the global EV and battery market.

AI and Robotics Industrial Cooperation: 'Data-Technology' Mutually Complementary Model

The AI and robotics industries, as core technologies of the Fourth Industrial Revolution, present a crucial domain where cooperation between Korea and ASEAN can establish a 'data-technology' mutually complementary model. Korea holds world-class technological capacity in hardware and algorithms, particularly in hyper-scale AI model development, AI semiconductors, and sensor technology. Conversely, ASEAN possesses abundant data resources driven by its population of 680 million and vibrant application markets across diverse industrial sectors. This complementarity provides decisive synergy for both regions to secure competitiveness in the global AI market.

According to International Data Corporation (2024), Vietnam, the Philippines, and Indonesia are rapidly emerging as AI training data hubs, underpinned by fast-growing data labelling and Natural Language Processing industries. This resource is essential for advancing Korea's AI technology and developing localized AI solutions.

Joint AI Research and Data Sharing Platform Establishment

Korea-ASEAN AI cooperation must evolve beyond simple technology transfer to include joint AI research and the establishment of data sharing platforms. These platforms perform the following core functions:

- **Data Exchange and Standardization:** Korea secures large-scale data essential for hyper-scale AI model training, while ASEAN contributes high-quality local data generated across diverse sectors like agriculture, tourism, and healthcare. This allows Korea to develop localized AI solutions, while ASEAN enhances its data utilization capacity by adopting Korean data standardization techniques.
- **Joint R&D Projects:** Research institutions and companies from both regions jointly develop AI technologies and execute projects, such as applying AI to Vietnam's smart agriculture and the Philippines' telemedicine systems, creating mutual benefits.
- **Human Resource Development:** Linking Korea's specialized AI training programs with ASEAN's young workforce fosters the development of local specialized personnel, ensuring the sustainability of the AI ecosystem.

This cooperative model effectively diffuses Korean AI technology into the ASEAN market while contributing to ASEAN's technological self-reliance capacity.

Smart Manufacturing and Logistics Robotics Sector

Korea's robotics manufacturing technology and AI-based solutions are core elements that can contribute to automating manufacturing and optimizing logistics efficiency in ASEAN. Countries like Vietnam and Thailand, with manufacturing-centric economic structures, have high demand for adopting smart factory solutions to boost productivity. Korea's AI-based smart factory solutions can improve manufacturing productivity by over 20% through process optimization, defect prediction, and energy management.

- **Logistics Automation:** ASEAN's logistics industry is growing rapidly but often suffers from underdeveloped infrastructure and operational systems. Korea's AI-based logistics robots, Automated Guided Vehicles (AGVs), and Warehouse Management System technologies can be applied to automate ASEAN's logistics warehouses and ports, maximizing logistics efficiency.
- **Expansion of Service Robotics:** Korea's service robotics technology (e.g., delivery, guidance, disaster response) can be applied in ASEAN's tourism, public safety, and healthcare sectors. Examples include deploying Korean guidance robots in Thai tourist attractions or sharing disaster response robotics technology in disaster-prone areas of the Philippines.

To systematically manage these cooperative projects, the establishment of a 'Korea-ASEAN AI Cooperation Platform' is necessary (Korea Institute of Science and Technology Information, 2024). This platform would serve as a control tower, involving governments, companies, and research institutions from both regions to formulate technology development roadmaps, identify joint projects, and support human resource exchange. This ensures a long-term partnership that organically links technology, human resources, and markets, rather than simple technology transfer.

Smart City Cooperation: 'Experience-Based' Joint Innovation Projects

Smart cities are a crucial solution for addressing urbanization and high population density challenges, and Korea-ASEAN cooperation can maximize synergy through 'experience-based' joint innovation projects. ASEAN is advancing the 'ASEAN Smart Cities Network' project, connecting 26 major cities by 2025, which translates into high demand for Korea's smart city development experience and technology. Korea can offer a win-win model by

leveraging its operational know-how from successful smart cities like Sejong, Busan, and Songdo for policy consulting and System Integration services.

Customized Solution Provision and Policy Consulting

Korea's experience in developing diverse smart city models tailored to urban characteristics and demands can play a crucial role in addressing the unique challenges faced by ASEAN cities.

- **Metropolitan Customized Solutions:** Large cities like Jakarta and Hanoi grapple with severe traffic congestion, air pollution, and energy shortages. Korea can provide an integrated smart city platform encompassing traffic, energy, and public safety to these cities. This involves optimizing traffic flow through AI-based traffic control systems and enhancing urban energy efficiency through smart energy management systems.
- **Industrial City Customized Solutions:** Smart manufacturing and logistics solutions are highly effective for industrial cities like Da Nang (Vietnam) and Batam (Indonesia). Korea can contribute to enhancing the industrial productivity and efficiency of these cities by providing AI-based smart factory technology, robotic automation systems, and smart logistics platforms.
- **Tourism City Customized Solutions:** Sustainable tourism development is vital for cities like Siem Reap (Cambodia) and Hoi An (Vietnam). Korea can help enhance tourist convenience and safety while reducing urban environmental pollution by providing smart tourism safety and environmental management systems.

This customized cooperation model emphasizes the importance of 'policy consulting,' working jointly on a blueprint for the sustainable development of local cities, extending beyond mere technology export (Ministry of Land, Infrastructure and Transport, Korea, 2024).

Joint R&D and Human Resource Development

To establish a sustainable smart city cooperation system, strengthening local human resource capacity is essential, beyond simple technology transfer. Korea and ASEAN can deepen cooperation by pursuing joint R&D on smart city technologies and operating local human resource development programs.

- **Joint R&D:** Korean research institutes (KIST, ETRI) and major ASEAN universities can execute joint R&D projects in diverse areas, including smart city platform localization, AI-based data analysis model development, and cybersecurity technology. This helps bridge the technological gap and develop innovative technologies tailored to local characteristics.
- **Professional Talent Development:** Operating a 'Smart City Academy' that links Korea's smart city training programs with ASEAN's young workforce can cultivate smart city operation experts, data analysts, and AI engineers. This human resource development effort moves beyond simple technology transfer, realizing a 'Co-Innovation' model where both regions jointly resolve problems and create new value (Korea Institute of Civil Engineering and Building Technology, 2024).

Korea-ASEAN smart city cooperation must transcend the mere stage of infrastructure construction, evolving into a comprehensive cooperation model that integrates technology, policy, and human resources, serving as a core driver for the sustainable urban growth of both regions.

Renewable Energy and Green Policy Cooperation: 'Technology-Resource' Combination for Carbon Neutrality

Responding to the climate crisis is a core global priority for both Korea and ASEAN. Both regions can establish a mutually complementary renewable energy ecosystem through a 'technology-resource' combined cooperation model to achieve carbon neutrality goals. Korea possesses world-class competitiveness in hydrogen, solar, and fuel cell technologies, alongside highly efficient power grid stabilization expertise through Energy Storage Systems (ESS). Conversely, ASEAN possesses vast natural resource potential, including wind, hydro, and biomass. This complementarity provides the impetus for sustainable growth cooperation between the two regions.

According to the International Energy Agency (IEA, 2023), Southeast Asia possesses abundant offshore wind and solar resources but lacks the necessary technology and capital to utilize them efficiently. Korean technology and capital can play a decisive role in bridging this gap.

Joint Carbon Reduction Projects and Technology Transfer

Korea-ASEAN renewable energy cooperation can be concretized through large-scale joint carbon reduction projects.

- **Offshore Wind Power Development:** Vietnam possesses the longest coastline and abundant offshore wind resources in Southeast Asia. Korea can invest in the construction of large-scale offshore wind farms in Vietnam and transfer related turbine and infrastructure technology. This provides new overseas market access for Korean firms while strengthening Vietnam's energy security and significantly reducing carbon emissions.
- **Hydropower Modernization:** Nations like the Philippines and Laos possess high hydropower potential, but the efficiency of many aging power plants is low. Korea can participate in hydropower plant modernization projects, improving generation efficiency and stabilizing the power grid through the application of smart grid technology. This enhances power supply stability, supports industrial development, and maximizes renewable energy utilization.
- **Biomass and Waste-to-Energy:** Indonesia and Malaysia have high potential for biomass generation utilizing agricultural waste (e.g., palm oil residue). Korea's waste-to-energy technology and biomass power generation operational know-how can help these nations improve energy efficiency while simultaneously addressing waste management issues.

Establishment of the 'Korea-ASEAN Renewable Energy Platform (KA-REP)'

Establishing a joint governance system such as the 'Korea-ASEAN Renewable Energy Platform (KA-REP)' is essential for sustainable and systematic cooperation. This platform would provide the foundation for long-term cooperation by performing the following roles:

- **Sharing Policy Experience:** Renewable energy policymakers from both regions would share policy successes and failures, identifying optimal policy directions tailored to each country's context. Korea's experience in implementing carbon taxes and green finance can offer critical insights for ASEAN nations' eco-friendly policy formulation.
- **Joint R&D and Technical Personnel Exchange:** The platform would facilitate joint R&D projects between research institutions and companies on next-generation renewable energy technologies (e.g., high-efficiency solar modules) and promote technical personnel exchange to bridge the renewable energy technology gap.
- **Stabilizing the Green Industrial Supply Chain:** This platform would contribute to establishing joint procurement and distribution systems for raw materials related to the green industry (e.g., recycled EV battery raw materials). This strategy helps jointly address global supply chain uncertainties and enhances the competitiveness of the green industry.

In conclusion, Korea-ASEAN renewable energy cooperation must evolve into a strategic partnership that integrates technology, resources, and policy experience, moving beyond mere power plant construction. This effort strengthens the energy security of both regions and contributes to achieving global carbon neutrality goals, serving as a critical driver for shared prosperity and sustainable futures.

4.2.5. Strategic Significance of Cooperation Amidst Supply Chain Realignment

Cooperation between Korea and ASEAN in sustainable smart innovation transcends the simple exchange of economic benefits, holding deep politico-economic and geopolitical significance within the complex 21st-century strategic environment. This collaboration is fundamentally established as a joint response strategy by both regions to three monumental challenges: the U.S.-China rivalry for hegemony, the post-pandemic uncertainty in global systems, and the imperative of the climate crisis.

Building Alternative Networks in an Era of Supply Chain Multipolarisation

Although the global order exhibits a tendency toward bipolarization centred on the U.S. and China, the phenomenon of supply chain multipolarisation is accelerating concurrently. Korea-ASEAN cooperation plays a

vital role in this multipolar era by reducing dependency on the U.S.-China centric order and fostering stable, alternative networks.

- **ASEAN's 'Non-Alignment' Foreign Policy Tradition:** ASEAN has historically maintained a non-aligned foreign policy tradition, refusing to be drawn into specific great power blocs. This aligns with Korea's own strategic need to secure autonomy amidst the competition between the U.S. and China. ASEAN's commitment to multilateral cooperation makes it a suitable partner for 'minilateral' cooperation structures involving Korea (e.g., the Korea-ASEAN Solidarity Initiative). Such collaboration provides a crucial foundation for both nations to seek a 'Third Way' that is not strictly aligned with any single hegemonic power.
- **Deepening Economic Interdependence:** The volume of Korea's trade with ASEAN reached approximately \$190 billion in 2023, positioning ASEAN as Korea's third largest trading partner after China and the U.S. (Korea Customs Service, 2024). This deepening economic interdependence signifies that the relationship between the two regions is evolving beyond mere commerce into a strategic partnership.
- **Strengthening Regional Security and Stability:** Competition between the U.S. and China contributes to heightened military tensions in the Southeast Asian maritime domain. Economic and technological cooperation between Korea and ASEAN can enhance stability in the region and broaden the diplomatic support base for conflict mitigation. For instance, joint training and projects combining Korea's advanced maritime security technology with the naval capabilities of ASEAN nations play a crucial role in strengthening regional maritime security and protecting key supply routes.

Regionalization of Global Value Chains (GVCs) and Supply Chain Optimization

The COVID-19 pandemic exposed the critical fragility of Global Value Chains, compelling corporations to prioritize stability and resilience over cost efficiency. This paradigm shift accelerates the trend of supply chain regionalization, driving the strategic relocation of manufacturing bases between Korea and ASEAN.

- **Production Base Relocation and the 'China+1' Strategy:** A significant number of global corporations are adopting the 'China+1' strategy, relocating production facilities from China to Southeast Asia. Korean firms

are actively participating in this trend, expanding EV, electronics, and textile manufacturing facilities in countries like Vietnam and Indonesia. This move aligns with a cost- and risk-management-centric supply chain optimization strategy aimed at mitigating logistical bottlenecks and geopolitical risk exposed during the pandemic.

- **Digital Logistics and Smart Infrastructure Cooperation:** Korea possesses expertise in AI-based smart logistics systems and digital customs clearance platform technology, while ASEAN is developing digital trade platforms like the 'ASEAN Single Window'. Integrating these technologies allows both regions to maximize logistics efficiency and streamline cross-border trade procedures, thereby increasing the stability and transparency of the intra-regional supply chain. This cooperation is instrumental in building a digital supply chain where information and data flow efficiently, moving beyond the simple movement of physical goods.
- **Advanced Manufacturing and Digitalization:** Korea's smart factory technology can play a decisive role in elevating the manufacturing competitiveness of ASEAN. Manufacturing-centric nations such as Vietnam and Thailand can receive assistance in adopting Korean AI and robotics-based solutions to enhance productivity and transition towards higher value-added industries. This process facilitates the modernization of ASEAN's economic structure while providing a new market application for Korean technology, creating mutual benefits.

The Geopolitical Value of Supply Chain Diversification

Korea's semiconductor and battery industries still maintain a high degree of reliance on specific nations. In particular, the dependence on China for materials, components, and equipment remains at a significant 30–40% level. This concentration poses a substantial economic security risk should the U.S.-China conflict escalate. Expanding cooperation with ASEAN acts as a 'strategic safeguard' to disperse this risk.

- **Securing Core Materials:** As previously analyzed, Indonesia's rich nickel resources are vital for securing the stable supply of raw materials for Korean battery companies. Cooperation with Indonesia enables Korea to diversify the EV battery supply chain away from China and enhance its preparedness against protectionist policies, such as the U.S. IRA (Inflation Reduction Act).

- **Linkage with International Cooperation Frameworks:** Korea-ASEAN cooperation is also crucial within broader international frameworks. Korea actively participates in the Indo-Pacific Economic Framework (IPEF) and the Regional Comprehensive Economic Partnership (RCEP) alongside partners like Japan, Australia, and India, where the Korea-ASEAN axis is central to supply chain stabilization (UN ESCAP, 2023). Given ASEAN's core membership in RCEP and active participation in IPEF, collaboration between the two regions contributes significantly to the successful operation of these vital frameworks.
- **Institutionalization of Advanced Technology Cooperation:** To institutionalize supply chain cooperation, Korea and ASEAN should establish a 'Korea-ASEAN Advanced Technology Cooperation Consultative Body.' This body would play a critical role in discussing technological standards for key industries (semiconductors, batteries, AI), jointly establishing R&D funds, and formulating policy guidelines for intellectual property protection. This initiative will create the institutional foundation necessary to foster stable investment and technological exchange for companies in both regions.

Joint Response to Climate Change and Energy Transition

Climate change and energy transition are no longer merely environmental concerns but core issues dictating economic and security stability. Cooperation between Korea and ASEAN in this domain is highly complementary.

- **ASEAN's Renewable Energy Potential and Demand:** ASEAN possesses abundant renewable energy potential, including solar, wind, hydro, and geothermal resources. Its rapidly growing economies and urbanization are driving an exponential increase in energy demand, presenting a vast market for the application of Korean energy technology.
- **Korea's Advanced Green Technology:** Korea holds advanced energy technologies, including hydrogen, solar power, and Carbon Capture, Utilization, and Storage. Combining Korean technology with ASEAN's abundant resources can enhance renewable energy generation efficiency, stabilize the power grid, and contribute to reducing industrial carbon emissions (Korea Energy Agency, 2024).
- **Joint Research and Investment:** Korea and ASEAN can pursue joint carbon reduction research and green infrastructure investment projects through the 'Korea-ASEAN Climate Change Response Partnership.'

This accelerates both nations' carbon neutrality goals and strengthens their international leadership on climate action.

- **Financing for Sustainable Development:** Korea's expertise in green finance technology and policy can assist ASEAN nations in efficiently mobilizing funds for renewable energy projects. Establishing a 'Korea-ASEAN Green Investment Fund' would jointly secure necessary capital for green infrastructure such as solar power plants, smart grids, and ESS, actively encouraging private sector participation.

In conclusion, Korea-ASEAN smart innovation cooperation is not merely technological exchange or economic engagement; it is an essential strategic choice for securing the economic survival and future prosperity of both regions amidst a complex global environment. This cooperation is evolving into a comprehensive partnership that secures supply chain stability, generates new growth engines, and builds a sustainable future together.

4.2.6. Necessity of Establishing the “Technology–Human Resource–Policy Triple Linkage Model”

Ultimately, for Korea-ASEAN cooperation to operate as a sustainable and structural collaborative system beyond short-term projects, it must move past simple technology transfer and production agreements to establish the 'Technology–Human Resource–Policy Triple Linkage Model' (Integrated Triadic Cooperation Model). This model represents the most comprehensive and long-term strategy for addressing the monumental geopolitical and industrial challenges posed by supply chain realignment.

Technology Linkage: Joint Innovation Platforms and Standardization Frameworks

Technology Linkage is the crucial step for bridging the technological gap between the two regions, ensuring interoperability, and building shared innovation capacity through Joint R&D and innovation platforms.

- **Joint R&D and Innovation Platform Establishment:** While Korea leads in advanced sectors (AI, semiconductors, EV batteries), these technologies require 'localized innovation' to function reliably in ASEAN's diverse environments (e.g., humid climates, varying power grid reliability). Establishing 'Korea-ASEAN Joint Innovation Centres' is necessary to drive joint R&D that combines Korean source technology with ASEAN's local data and application environments. For example, joint research to optimize Korea's

smart grid technology for Vietnam's decentralized solar power systems is feasible (Korea Institute of Science and Technology Information, 2024).

- **Establishing Joint Standardization Frameworks:** Standardization is essential for diffusing smart innovation technologies. Establishing joint standards for EV charging interfaces, Smart City data platform APIs (Application Programming Interfaces), and AI training data formats minimizes technical barriers and costs for firms entering mutual markets. This aligns with ASEAN's 'Digital Integration' goals and offers Korea the strategic advantage of having its technologies become the market standard in ASEAN.

Human Resource Linkage: Building Sustainable Technical Infrastructure

Human Resource Linkage establishes the social and sustainable foundation for cooperation. Without local professional personnel to operate, maintain, and adapt transferred technologies, collaboration risks becoming merely a short-term project.

- **Customized Education and Training Programs:** Advanced Korean education models, such as AI Graduate Schools and Smart Factory Meister Training, must be transferred to ASEAN universities and vocational training institutions. Focused efforts should be made to cultivate specialized personnel in core smart innovation fields, such as AI data scientists, EV battery recycling engineers, and smart grid operators (Ministry of Education, Korea, 2024).
- **Technology Exchange and Personnel Exchange Programs:** Expanding 'Technology Exchange and Training Programs,' where young researchers and engineers from both nations work or study in the partner country for defined periods, is necessary. This fosters long-term cooperation networks and deepens cultural understanding beyond mere skills acquisition.
- **Deepening Higher Education Cooperation:** Strengthening joint academic research and degree programs between Korea's major Science and Technology universities (KAIST, UNIST, etc.) and ASEAN's leading technical universities is vital to jointly cultivate advanced human capital in smart innovation. These individuals will become core leaders for future Korea-ASEAN joint projects.

Policy Linkage: Institutional Stability and Supply Chain Governance

Policy Linkage is crucial for securing the institutional stability of cooperation and enhancing predictability for businesses in both regions.

- Supply Chain Strategy Meetings and Industrial Policy Dialogues: Institutionalizing a regular 'Korea-ASEAN Supply Chain Strategy Consultative Body' is necessary to share information on core raw material sourcing, technological standard changes, and geopolitical risks, allowing for joint discussion of countermeasures. This body should evolve into a governance form encompassing security/diplomacy experts and industry leaders, not just economic officials.
- Investment Guarantee Agreements and Regulatory Harmonization: To encourage Korean corporate investment in the ASEAN region, Investment Guarantee Agreements must be strengthened, and Regulatory Harmonization must be pursued, particularly for new technologies like EV and AI. Joint discussion of AI ethical norms, such as data privacy laws (PDPL), can create an institutional environment allowing Korean firms to operate without local market uncertainty (Ministry of Foreign Affairs, Korea, 2024).
- Joint Fund Creation and Financial Support: A 'Korea-ASEAN Green and Digital Investment Fund' must be established to finance smart innovation infrastructure development. Collaborative capital mobilization by Korean policy financial institutions (KDB, Export-Import Bank) with ASEAN development banks (ADB, AIIB) will attract private investment into large-scale projects like EV charging stations, smart grids, and AI data centres.

Conclusion: Evolution to a Co-Prosperity Innovation Partnership

Ultimately, global supply chain realignment is not a mere relocation of production sites but a complex redesign process of the entire technological, policy, human resource, and industrial network. Korea and ASEAN, as mutually complementary partners with technology innovation and production/resource foundations, form an optimal combination for establishing shared value chains. Korea maintains a complementary position in technology-intensive advanced industries, while ASEAN's strength lies in resources, demographics, and geography. Consequently, both regions must establish a 'Co-managed Value Chain' regime to concurrently secure stability, efficiency, and sustainability.

Future cooperation must shift its focus: from technology-centric to human resource-centric, from industry-centric to ecosystem-centric, and from short-term projects to long-term joint value creation. Achieving this requires Korea and ASEAN to establish a new cooperation governance integrating joint research, industrial linkage, human resource development, and policy coordination. The convergence of smart innovation and supply chain strategy will transcend mere economic cooperation, becoming a core pillar for forming the foundation of sustainable prosperity and technological self-reliance in the East Asia region.

This policy synchronicity strengthens the institutional foundation of Korea-ASEAN cooperation and enables both regions to assume the role of 'co-architects' in the global supply chain.

Table 34. Mutually Complementary Policy Framework

Category	Korea	ASEAN
Policy Vision	K-Supply Chain 3.0 (2023)	ASEAN Comprehensive Recovery Framework (2022)
Objective	Diversification of core materials/components supply chain	Strengthening intra-regional industrial resilience
Strategy	Advancement centred on technological capability	Integration centred on production and logistics
Cooperation Stance	Establishment of interdependent value chains	Expansion of external technology/capital attraction

4.3. Cooperation Strategy: Technology Transfer, Industrial Linkage, Human Resource Development, and Cooperative Projects

4.3.1. Introduction: Necessity of Structural Transition in Korea-ASEAN Cooperation

The structural realignment of global supply chains and the intensification of technology hegemony competition demand a new policy and technological partnership model that transcends mere trade and investment cooperation. While Korea and ASEAN have engaged in cooperation focused on trade, investment, and Official Development Assistance (ODA) since the 1990s, the cooperation paradigm post-2020 must evolve into a "Co-Innovation" model centred on advanced industries.

This shift involves moving beyond simple technology transfer to encompass the co-design of industrial ecosystems, the co-training of human resource capacity, and the co-governance of policy standards. Where past cooperation was defined by a vertical structure of 'technology provider-recipient,' future collaboration requires 'co-evolution' centred on joint research, industrial ecosystem linkage, human resource exchange, and joint policy design. Korea possesses strengths in technology, policy, and institutional design, while ASEAN's strengths lie in market access, human resources, and resource endowment. Therefore, the 'Integrated Triadic Cooperation Model' (Technology–Human Resource–Policy) becomes the core of the future cooperation strategy.

Sectors such as semiconductors, electric vehicles, batteries, AI, robotics, digital infrastructure, and renewable energy occupy a core position in the Global Value Chain. Strengthening Korea-ASEAN cooperation in these sectors will maximize mutually complementary synergy across technology, markets, demographics, and policy.

4.3.2. Technology Transfer and Co-Development

Paradigm Shift in Technology Cooperation

Traditional technology transfer between Korea and ASEAN largely adopted a unidirectional mode of knowledge diffusion. Specifically, technology was unilaterally transferred through Korean firms' entry into local markets, technical licensing agreements, and short-term training programs. However, analysis by the Asian Development Bank (ADB, 2023) indicates that this one-sided approach has exposed limitations concerning sustainability and self-reliance, often resulting in a 'technology-dependent structure' lacking local maintenance capacity and effective assimilation post-transfer. Evidence of this includes instances where certain smart city projects or electronics industry clusters in ASEAN failed to secure self-sufficiency after technology transfer.

The necessity now exists for Korea-ASEAN cooperation to transition towards a model of co-development and co-implementation based on mutual learning. This new paradigm facilitates the formation of a sustainable technological ecosystem when Korea's advanced technological capacity converges with ASEAN's vast market base and localized demand for problem-solving technologies. Recognizing this paradigm shift, the Korean government is actively pursuing two-way cooperation through the "K-Tech Global Partnership Program (2024)". This program involves transferring AI, battery, and smart city technologies to various ASEAN nations while simultaneously establishing joint research centres. For example, the K-AI Innovation Center in Hanoi, Vietnam,

the K-Battery Tech Center in Jakarta, Indonesia, and the Smart Manufacturing Testbed in Kuala Lumpur, Malaysia, are operating as hubs for co-development and practical validation, transcending simple technical assistance. These hubs specifically promote local adaptation of technology and contribute to strengthening the technological self-reliance capacity of ASEAN nations.

Establishment of Joint R&D Hubs and Expansion of the Technological Ecosystem

Korea and ASEAN must shift the technology cooperation paradigm from 'knowledge transfer' to 'Co-creation'. This necessitates the establishment of joint R&D hubs in key ASEAN nations. These hubs must be designed as integrated ecosystems that connect the entire innovation cycle, spanning from technological development and prototype production to industrialization and local human resource training, rather than functioning merely as isolated research facilities. Crucially, collaboration between Korean government-funded research institutes (e.g., KIET, ETRI, KIER) and local ASEAN universities and public research institutes will serve as the essential pathway for securing both technological internalization and industrial sustainability.

The table below summarizes the current status of Korea-ASEAN technological cooperation, including ongoing or concretely discussed initiatives.

Table 35. Status of Korea-ASEAN Technological Cooperation

Country	Cooperation Sector	Key Korean Partner	Form of Cooperation
Vietnam	AI & Data Analytics	Naver, ETRI	Joint R&D in AI application technology
Indonesia	Battery & EV	LGES, Hyundai Motor	Establishment of mineral-manufacturing integrated value chain
Malaysia	Semiconductor & Smart Manufacturing	SK Hynix, KIAT	Joint industrial development based on testbeds
Thailand	Smart City & Digital Government	Korea Expressway Corp., KICT	Demonstration of integrated traffic and energy solutions
Philippines	Renewable Energy	Hanwha Solutions, KIER	Joint research projects on Solar PV and ESS

Source: Ministry of Trade, Industry and Energy, Korea (2024); ASEAN-Korea Center (2024).

This cooperative model facilitates the co-ownership of technological leadership, concurrently enhancing the local adaptation and market suitability of the technology. Ultimately, technology transfer must be redefined as a process for establishing a joint innovation ecosystem, rather than unilateral support.

Deepening Co-Development and Localization Strategies

Deepening co-development and localization strategies enables technological cooperation that actively considers the diverse socio-cultural and geographical characteristics of ASEAN. This involves optimizing technology and creating new value through cooperation with local enterprises and experts, rather than simply transplanting Korean technology.

- **Localization of Smart City Solutions:** Korea's smart city integrated platform must be adapted and refined to address the unique challenges of individual cities, such as mitigating traffic issues in Hanoi, Vietnam, or enhancing disaster management in Manila, the Philippines. Joint development of AI algorithms optimized for local data and infrastructure is crucial. For instance, Korean and Vietnamese researchers collaborating to develop an AI traffic control model tailored to Hanoi's complex road network exemplifies this approach. Introducing a model where Intellectual Property generated during this process is jointly owned by both countries enhances the sustainability of the cooperation.
- **Sector-Specific Localization of AI Technology:** Projects can be pursued to localize AI-based smart agriculture solutions for Vietnam's agricultural sector or AI-based diagnostic systems for Thailand's healthcare sector. For instance, jointly developing an AI pest and disease prediction system optimized for Vietnamese rice farming can simultaneously boost Vietnam's agricultural productivity and apply Korean AI technology to a new market.
- **Localization of Renewable Energy Technology:** Joint research is necessary to optimize Korea's smart grid and ESS technology for the local power grids in the Philippines and Indonesia, leveraging their abundant geothermal and hydro resources. This enhances technical efficiency and contributes to technical internalization by increasing the understanding of local experts.

This strategy of joint development and localization is core to establishing a 'co-evolutionary technological ecosystem' where Korea and ASEAN grow together through two-way interaction, not unilateral flow. This establishes a crucial foundation for strengthening both nations' technological self-reliance capacity and securing a competitive edge in the international market amidst global supply chain realignment.

4.3.3. Strengthening Industrial Linkage

Horizontal Integration of Industrial Ecosystems - Transition to Value Chain-Centric Cooperation

The coexistence of Korea's large corporation-centric industrial structure and ASEAN's SME-centric economy creates a mutually complementary structure. Consequently, strengthening inter-industrial connectivity between the two regions is essential for cooperation. Furthermore, Korea-ASEAN industrial cooperation must now transition to a phase of 'Value Chain Integration,' moving beyond simple component trade. This involves establishing joint manufacturing ecosystems by combining Korea's high value-added components and materials with ASEAN's assembly and production capacities. This approach is indispensable for minimizing global supply chain uncertainty and concurrently strengthening the industrial competitiveness of both nations.

The K-ASEAN Smart Industry Platform is proposed to facilitate this value chain integration. This platform is designed as a supply chain integration interface involving simultaneous participation from Korean large corporations, startups, ASEAN SMEs, and government agencies. Operating as a digital industrial cooperation infrastructure, it encompasses industrial data sharing, supply chain Traceability, ESG information management, and a joint certification system. A pilot project for this platform is scheduled for 2025 (Korea Institute for Industrial Economics & Trade, 2024).

Table 36. K-ASEAN Smart Industry Platform: Key Contents and Expected Outcomes by Phase

Phase	Key Contents	Expected Outcomes
Phase 1	Sharing Industrial Information (Supply chain, investment, human resource data)	Strengthening the foundation of mutual trust
Phase 2	Establishment of production cooperation networks among SMEs	Enhancing industrial ecosystem diversity

Phase 3	Development of a joint brand (K-ASEAN Green Tech)	Promoting joint entry into the global market
Phase 4	Operation of joint ESG/Digital Transformation certification system	Realizing sustainability and regulatory harmonization

Source: Korea Institute for Industrial Economics & Trade (2024); ASEAN Secretariat (2023); UN ESCAP (2023).

This industrial linkage strategy must move beyond simple OEM/ODM level cooperation towards joint standardization and co-market expansion. Korean firms have already established cluster-type industrial cooperation models, centred on nations such as Vietnam (Samsung Electronics, LG Electronics), Malaysia (Hyundai Mobis), and Indonesia (LGES, POSCO). These cases are recognized as best practices for achieving regional diversification of the industrial ecosystem beyond merely optimizing supply chain efficiency. For example, the 'EV Battery Alliance' pursued by Korea's SK Innovation and the Indonesian government, and the 'AI Platform for Smart Manufacturing' between Vietnam and Korea, are representative of this industrial linkage model. This model utilizes Korea's technological capacity to advance ASEAN's production base and includes strategies for joint market expansion by firms from both nations.

Deepening Industrial Value Chain Integration Strategies

EV and Battery Industry: 'Raw Material-Technology-Market' Integrated Model

The EV and battery industries are the most critical axis of industrial linkage between Korea and ASEAN. Korea possesses world-class competitiveness in core battery materials and technology, such as cathode materials, anode materials, and separators. Conversely, Indonesia is the main production site for battery raw materials like nickel and cobalt (United States Geological Survey, 2024). The core strategy involves establishing a vertical value chain within the ASEAN region, spanning from 'raw material mining and processing → battery material production → cell/module manufacturing → finished vehicle assembly → end-of-life battery recycling' by combining these strengths.

A prime example of this cooperation is the LG Energy Solution and Hyundai Motor Group joint battery cell plant in Indonesia. LG Energy Solution provides battery manufacturing technology, Hyundai Motor Group handles

finished vehicle production, and local partners supply raw materials and components, establishing an integrated ecosystem. This model is a 'win-win' strategy, as it secures stable sourcing of Indonesia's abundant nickel resources while diffusing Korean corporate technology into the ASEAN market.

Semiconductor Industry: 'Front-end-Back-end' Linked Cluster

The semiconductor supply chain is divided into front-end and back-end processes. Korea holds dominant technological capacity in front-end processes, particularly memory chip manufacturing, while Malaysia has emerged as a global hub for back-end processes (OSAT: assembly, test, and packaging) (Malaysia Investment Development Authority, 2024).

The cooperation mechanism involves Korean semiconductor companies expanding their back-end production bases in areas like Penang, Malaysia, and strengthening technological cooperation with local firms to establish a 'Korea-Malaysia Semiconductor Back-end Cluster'. This secures a stable semiconductor supply chain for Korea and contributes to Malaysia's transition to higher value-added industries by elevating its technological capacity.

AI and Robotics Industry: 'Technology-Application' Integrated Ecosystem

Cooperation between Korea and ASEAN in the AI and robotics sectors must move beyond simple technology transfer toward applying technology to local industries to create new business models.

- **Smart Manufacturing:** Korean AI-based smart factory solutions are highly relevant for manufacturing-centric economies like Vietnam and Thailand, enhancing productivity and efficiency. Joint projects can be pursued to develop and localize AI-based robots for quality inspection and automated logistics systems.
- **Smart Agriculture and Healthcare:** Cooperation in applying AI technology to core ASEAN industries like agriculture and healthcare is important. Joint development of AI-based crop management systems to enhance agricultural productivity in Cambodia and Laos, and the establishment of telemedicine systems to improve healthcare access, are key targets.

Structural Constraints of Cooperation and Mechanisms for Balanced Development

The intensification of industrial linkage carries the risk of exacerbating existing disparities among ASEAN member states. For instance, countries such as Singapore, Malaysia, and Vietnam rapidly absorb technology-intensive industries. In contrast, nations with weaker industrial bases, such as Laos, Cambodia, and Myanmar, face the risk of marginalization as 'Tier 2 Cooperation Participants'.

Therefore, cooperation policy must explicitly incorporate a Balanced Development Mechanism within ASEAN.

- **Differentiated Cooperation Models:** A differentiated cooperation model tailored to the development stage of each ASEAN country must be applied. Cooperation with technological leaders (Singapore, Malaysia) should focus on joint R&D and technological standardization, while cooperation with developing nations (Laos, Cambodia) should prioritize infrastructure development and human resource capacity building through Official Development Assistance.
- **Linkage with Development Cooperation:** Korea's ODA should be strategically focused on smart innovation sectors to support ASEAN developing countries in establishing smart infrastructure and training technical personnel. This represents a strategic investment that establishes the foundation for long-term industrial linkage, moving beyond simple aid.

In conclusion, Korea-ASEAN industrial linkage must evolve beyond mere economic benefits into a comprehensive and sustainable cooperation model that integrates mutually complementary value chains and promotes balanced development within the ASEAN region. This strategy is an essential driver for both nations to pursue joint prosperity amidst the restructuring of the global supply chain.

4.3.4. Human Resource Development

The Importance of Resolving the Technology-Skills Mismatch

The sustained success of cooperation between Korea and ASEAN fundamentally hinges upon the quality of human capital. Currently, while ASEAN nations are experiencing rapid infrastructure growth and active technology adoption, a persistent shortage of skilled personnel in advanced industrial sectors—such as smart cities, AI, robotics, and eco-friendly energy—remains a structural impediment. This phenomenon, known as the 'technology-

skills mismatch,' is a major constraint on collaborative progress. To address this deficiency, Korea established the ASEAN-Korea HRD Center (2022), which operates educational programs in AI, robotics, smart city management, and eco-friendly energy. However, reports from the Korea International Cooperation Agency (KOICA, 2024) indicate that current programs are predominantly focused on short-term training, resulting in insufficient linkage with local industries. Consequently, this limits the genuine internalization of skills by local personnel, often confining technological knowledge to a superficial level of acquisition.

Overcoming these limitations and establishing a robust foundation for long-term cooperation necessitates a fundamental shift in human resource development strategy. A comprehensive approach is required that moves beyond merely teaching technology, focusing instead on providing education closely linked to local industry, reinforcing institutional frameworks for cooperation, and expanding two-way personnel exchange.

Deepening Joint Education and Training Systems

To transcend the constraints of short-term training programs, the system must be upgraded through the introduction of Joint Master Programs and Co-Certification Systems for Technicians.

These initiatives can be designed as joint ventures between Korea's leading higher education institutions (e.g., KAIST, POSTECH) and key ASEAN technical universities (e.g., Asian Institute of Technology (AIT), Chulalongkorn University, Bandung Institute of Technology (ITB)). Joint Master Programs should involve faculty from both Korea and ASEAN collaboratively developing curricula and students undertaking cross-campus studies to acquire both theoretical knowledge and practical expertise. Specialized joint Master's programs should be established in advanced fields such as AI, data science, and robotics to jointly cultivate the high-level talent needed to lead future industries. For example, the proposed joint Master's program in AI and Data Analytics between the Korea Advanced Institute of Science and Technology (KAIST) and Hanoi University of Science and Technology (HUST) envisions providing hybrid education that integrates online learning with hands-on field practice.

The Co-Certification System for Technicians is designed to mutually recognize the technical standards and vocational education systems of both regions. This system allows local ASEAN technicians, upon acquiring Korean smart innovation technology, to obtain a jointly recognized certification, thereby elevating the professionalism and credibility of the local workforce. Notably, the collaboration between POSTECH and Indonesia's ITB in the field of robotic automation is contributing to strengthening technicians' practical capabilities through industry-focused internship programs. Such institutionalization is significant as it disseminates not only technical skills but also policy acumen and capacity for innovation leadership. The goal is to establish a Co-Talent Ecosystem for future innovation, moving beyond simple human resource production.

Table 37. Status of Korea-ASEAN Joint Education Exchange

Education Sector	Key Contents	Partner Institutions
AI & Data Science	Establishment of joint Master's programs, hybrid online + field training	KAIST – Hanoi University
Robotics & Automation	Industry-centric practical training programs	POSTECH – ITB (Indonesia)
Smart City Management	Education linking public administration and urban technology	KDI – NUS (Singapore)
Renewable Energy	Cultivation of carbon-neutral technology personnel	KIER – AIT (Thailand)

Source: ASEAN-Korea Center (2024), UNESCO TVET Report (2023).

Establishing a Digital Talent Platform for Human Resource Circulation

To systematically manage human resource exchange in digital technology sectors like AI, robotics, and the Internet of Things (IoT), the establishment of an 'ASEAN–Korea Digital Talent Platform' is essential. This online network connecting learners, companies, and educational institutions will be equipped with the following core functionalities:

First, joint curriculum and educational content provision is key. Utilizing Korea's advanced online educational content and local data from ASEAN nations, joint curricula can be developed. This ensures that ASEAN students

can access cutting-edge technology education without temporal or geographical constraints. This initiative effectively extends Korea's 'K-Digital Training' model globally.

Second, an online qualification examination and certification system must be implemented. The platform can host online qualification exams in specific fields such as AI, Big Data analytics, and smart city operations, granting successful candidates a joint Korea-ASEAN certification. This expands job opportunities for ASEAN personnel within Korean companies and concurrently assists Korean companies in efficiently recruiting necessary personnel locally.

Third, a field internship matching function is required. The platform will connect local subsidiaries of Korean companies with qualified ASEAN students to provide practical field experience. This allows students to gain hands-on experience applying technology in real industrial settings, while companies contribute to scouting potential future talent.

This digital platform will be linked with Korea's 'K-Digital Training' and ASEAN's 'Digital Masterplan 2025,' facilitating the regional circulation of human resources. Given the difficulties small and medium-sized enterprises (SMEs) face in developing their own human resource systems, this platform will be of significant assistance in alleviating their technical staffing shortages.

In conclusion, cooperation in human resource development must move beyond simple knowledge transfer. It must prioritize establishing a joint education system and digital platform to bridge the technological gap between the two regions and foster a mutually complementary innovation talent ecosystem. This represents the most vital investment for a long-term cooperative relationship and a core foundation for the sustainable smart innovation of both nations.

4.3.5. Cooperative Projects

Cooperative projects are the core executive mechanism for Korea-ASEAN collaboration in smart innovation, applying across all sectors including smart cities, battery/EV, AI/Robotics, and renewable energy. These projects

function as comprehensive collaborative mechanisms that integrate technology transfer, industrial linkage, and human resource development, serving as essential instruments contributing to the sustainable development of both regions.

Collaboration Based on the ASEAN Smart Cities Network (ASCN)

ASEAN has been advancing the ASEAN Smart Cities Network (ASCN) project, targeting 26 cities since 2018. Korea is participating as a key partner, sharing its successful smart city models (Sejong and Busan) and providing technical consulting, traffic systems, and energy management solutions. This collaboration moves beyond the traditional unidirectional technology transfer model, adopting a Co-Implementation model that pursues two-way interaction. Korea supplies advanced technology, and ASEAN provides local validation data and feedback to optimize the technology for the local environment.

Specific examples of cooperation include:

- Da Nang, Vietnam: Korean smart traffic management solutions are being applied, utilizing AI-based traffic signal control and real-time traffic information systems to improve urban traffic flow. This serves as an exemplary case of Korean technology directly contributing to solving local urban challenges.
- Chonburi, Thailand: A pilot project for smart industrial complex development, utilizing Korean IoT technology for enhanced production efficiency and energy management optimization, is underway in the Eastern Economic Corridor (EEC).
- Kuala Lumpur, Malaysia: Korean companies are jointly developing an AI-based waste management system. This system analyzes urban waste data to optimize collection routes and enhance recycling rates.

This co-implementation model creates a virtuous cycle that simultaneously achieves technology transfer, localization, and economic effect creation.

Expansion of Public-Private Partnership (PPP) Projects

The substantial initial investment costs and technical risks inherent in smart infrastructure development necessitate the active utilization of the Public-Private Partnership (PPP) model. The participation of Korean public

and private enterprises in ASEAN urban development projects is regarded as a pioneering model for future cooperation.

The following table presents the status of ongoing Korea-ASEAN Public-Private Partnership (PPP) projects.

Table 38. Status of Korea-ASEAN Public-Private Partnership (PPP) Projects

Project Name	Key Contents	Participating Institutions
Da Nang Smart City	Traffic management, energy efficiency, urban monitoring	KICT, Da Nang City Gov.
Chonburi Smart Industrial Complex	IoT-based production efficiency	KICOX, EEC Thailand
Kuala Lumpur Green City	Smart waste and water treatment systems	KECO, DBKL
Jakarta EV Value Chain	Battery plant and charging infrastructure establishment	Hyundai, LGES, BKPM

Source: KOTRA (2024), ASEAN Smart Cities Network Annual Report (2023).

These joint projects focus on combining the infrastructure development and operational know-how of Korean public enterprises (e.g., K-Water, KEPCO, LH) with the advanced technological capacity of private firms (e.g., Hyundai Motor, LG Energy Solution). Furthermore, these projects operate as comprehensive cooperation mechanisms that integrate technology transfer, industrial linkage, and human resource development, contributing to establishing the foundation for sustainable growth in ASEAN nations.

Renewable Energy Cooperation Project: 'K-ASEAN Renewable Energy Partnership' (KAREP)

ASEAN's power demand is projected to increase by 80% by 2030, with over half of this growth expected to be met by clean energy sources (IEA, 2024). To support this energy transition, Korea is proposing the 'K-ASEAN Renewable Energy Partnership' (KAREP). This project involves more than simple technology provision, encompassing joint investment and technology transfer projects that combine the strengths of both regions.

- **Joint Construction of Solar and Offshore Wind Power Plants:** Projects can be pursued where Korean companies jointly construct and operate power plants, leveraging the abundant solar and offshore wind resources of Vietnam and the Philippines. For instance, Hanwha Solutions, a Korean firm, is participating in offshore wind power development in Vietnam, creating tangible cooperation examples.
- **Smart Grid and ESS Technology Transfer:** To mitigate the intermittency challenge of renewable energy, Korea's smart grid and Energy Storage System (ESS) technology can be transferred to ASEAN nations, modernizing their power grids. This enhances ASEAN's energy security and maximizes renewable energy utilization. The KAREP project is estimated to achieve a 12% reduction in carbon emissions across ASEAN by 2030 (KEEI, 2024).

AI and Robotics Cooperation Project: 'AI ASEAN Challenge 2030'

The AI and robotics sectors are highly suitable for combining Korea's technological capacity with ASEAN's abundant human resources and market. To this end, there is a need to jointly host the 'AI ASEAN Challenge 2030' to promote technical competition and research networking among young ASEAN developers.

- **Technical Competition and Personnel Exchange:** The challenge could call for projects solving specific problems in smart cities, healthcare, or agriculture using AI technology. Top teams could be offered internships at major Korean private companies (Naver, Kakao, LG CNS).
- **Joint R&D and Technology Commercialization:** Excellent ideas identified through the challenge can be developed into actual commercialization projects via the 'Korea-ASEAN Joint AI Research Institute'. For example, a project could jointly develop an AI-based prediction model to solve rice pest and disease problems in Vietnam, followed by its deployment to local farms nationwide.
- **Policy and Institutional Support:** For the challenge to succeed, the governments of Korea and ASEAN must strengthen institutional support for AI technology development and utilization, including data sharing policies, human resource development programs, and Intellectual Property protection.

These joint projects extend beyond simple economic cooperation, playing a critical role in strengthening the collective identity of Korea and ASEAN as a community that jointly addresses future challenges and creates new opportunities.

4.3.6. Institutional Support: Establishing a Korea-ASEAN Smart Innovation Governance Framework

Securing robust institutional support is indispensable for ensuring that Korea-ASEAN smart innovation cooperation transcends isolated projects and evolves into a long-term, sustainable partnership. To achieve this, the establishment of a standing organization, such as the Korea-ASEAN Smart Innovation Initiative (KASII) Committee, is required. This committee must function as a control tower, organically integrating technology, human resources, and policy from both sides, and efficiently coordinating complex cooperation tasks. The establishment of this governance framework is crucial not merely for maximizing collaboration efficiency but also for reinforcing the joint identity of both regions as they pursue shared objectives, moving beyond the simple context of cooperation.

The Role and Composition of the Korea-ASEAN Smart Innovation Cooperation Committee (KASII)

KASII must be designed as a comprehensive governance model encompassing governments, industry, academia, and international organizations from both regions. This committee will be responsible for strategic planning, execution, and evaluation across all phases of cooperation.

Table 39. Example of Korea-ASEAN Smart Innovation Governance

Component	Role
Government Representatives (Ministries of Industry/Science, ASEAN Member State Industry Ministries)	Policy coordination and budgetary consultation
Industry-Academia-Research Partners (Universities, National Research Institutes)	Joint project design and R&D linkage
Private Enterprises and Investors (Large corporations, Startups, Venture Capital)	Technology commercialization and capital mobilization
International Organizations (ADB, UN ESCAP, etc.)	Policy monitoring and mediation

The key functions of this committee are multifaceted. First, policy and strategic coordination is paramount. It must mutually link the smart innovation policies of each nation (e.g., Korea's K-Supply Chain 3.0, ASEAN's Digital Masterplan 2025), formulating joint strategies that maximize synergy while preventing duplication. Second, joint project identification and management is critical. The committee is responsible for identifying concrete joint projects in core sectors like EV batteries, smart cities, and AI, and coordinating the necessary financial and administrative support while monitoring project progress. Third, conflict mediation and resolution is necessary. It must proactively prevent conflicts arising during cooperation—such as disputes over technical standards, Intellectual Property (IP), and investment—and act as a mediator to propose efficient resolutions. Fourth, performance evaluation and knowledge sharing are vital functions. The committee can host an annual 'Korea-ASEAN Smart Innovation Forum' to share collective achievements and set the agenda for the subsequent year's cooperation. This forum must function as a platform for exchanging innovative ideas, involving not just intergovernmental bodies but also the private sector and academia.

Policy Mechanisms for Strengthening the Institutional Foundation

For the successful operation of KASII, the following institutional mechanisms must provide essential support.

Investment and Technology Protection Agreements in Smart Innovation: Institutional safeguards must be established to encourage Korean firms to confidently invest and transfer technology to the ASEAN region. Executing a 'Korea-ASEAN Smart Investment Guarantee Agreement' strengthens asset protection for investing firms, and establishing a 'Joint Intellectual Property Protection System' prevents technology leakage and illegal replication. These measures are essential for creating an environment where Korea's advanced technology can securely diffuse across the ASEAN region. The World Bank (2024) previously noted the urgency of strengthening intra-regional norms regarding technology transfer and IP protection to improve the investment climate in ASEAN.

Establishment of Joint Technical Standards and Certification Systems: Ensuring the interoperability of smart innovation technologies requires the joint formulation of technical standards. For instance, establishing shared standards for smart city integrated platforms, EV charging interfaces, and AI training data formats minimizes technical barriers and costs for firms entering mutual markets. Furthermore, introducing a 'Korea-ASEAN Smart Technology Joint Certification System' allows products and services meeting this standard to benefit from

streamlined licensing procedures when entering both markets. This significantly contributes to lowering technical barriers and accelerating technological exchange between the two regions (Korea Institute of Science and Technology, 2024).

Digital Governance and Data Utilization Cooperation: Data forms the core of digital innovation cooperation. Korea possesses advanced experience in data governance, including public data opening and AI-based policy decision-making. Sharing this expertise with ASEAN is necessary to strengthen each nation's data utilization capacity and resolve data standardization issues. Specifically, executing a 'Korea-ASEAN Data Sharing Agreement' establishes the institutional framework for utilizing anonymized or non-sensitive data for joint research. Additionally, establishing a joint response system for cybersecurity threats is important for enhancing the stability of smart infrastructure. The UN Economic and Social Commission for Asia and the Pacific (UN ESCAP, 2023) underscored that data governance cooperation is a core factor accelerating the growth of the digital economy in the Asian region.

Joint Vision and Leadership Building: Ultimately, the Korea-ASEAN smart innovation governance must function as a platform for building a shared vision and leadership, moving beyond a simple cooperative body. This enables both regions to serve as 'Co-architects' in jointly designing the future of global smart innovation.

- **Integration of Sustainability Goals:** Establishing joint sustainability goals that integrate Korea's 'Carbon Neutrality 2050' target and ASEAN's 'Energy Transition Roadmap' is crucial, along with executing concrete cooperation projects to achieve them. For example, joint targets for expanding renewable energy generation, EV adoption, and Carbon Capture technology development can be set, with annual progress monitored through the forum.
- **Sharing Innovation Leadership:** Developing an innovation leadership model that combines Korea's smart innovation policy experience with ASEAN's dynamic market experience is essential. This contributes to both nations leading global technical standards and pioneering new technological paradigms. The synergy between Korea's advanced technology and ASEAN's young demographics and market holds the potential for creating new forms of innovation. This leadership will be a vital driver for smart innovation across the Asian region.

In conclusion, the establishment of a governance framework like the 'Korea-ASEAN Smart Innovation Committee' is indispensable for institutionalizing cooperation, enhancing stability, and sharing a long-term vision and objectives. This will form the strategic foundation for establishing a comprehensive partnership that encompasses technology, human resources, and policy, jointly addressing the challenges of global supply chain realignment and the climate crisis.

4.3.7. Conclusion: The Necessity of Integrated Smart Innovation Cooperation

The key takeaway from the in-depth analysis across Chapter 4's strategies—technology transfer, industrial linkage, human resource development, and joint projects—is that the Korea-ASEAN cooperation strategy must be rooted in "Co-creation, not simple transfer," a point strongly reiterated throughout the study. This collaboration must be understood as a governance model for policy integration and joint growth, moving beyond the confines of mere economic cooperation. The ultimate objective of Korea-ASEAN cooperation is to build an "Integrated Smart Innovation Platform encompassing Policy–Technology–Human Resources–Industry."

This integrated cooperation model represents the most strategic and efficient joint response by both regions to the complex challenges of 21st-century global supply chain realignment and the climate crisis. By combining Korea's leading technological capacity and policy experience with ASEAN's dynamic market and resource potential, both regions can maximize mutual complementarity and emerge as co-architects of the global innovation order.

The policy implications of this cooperative framework are structured as follows:

Policy Dimension: Harmonization of Regulations and Standards for Joint Governance

The first core pillar of the integrated smart innovation platform is securing Policy Synchronicity. Governments in both regions must institutionalize genuine Industrial Policy Dialogue that moves beyond simple information exchange to harmonize regulations and standards. The current disparities in technical standards and regulations within ASEAN's existing frameworks (ASCN, ADM 2025) are key barriers to market entry and technological

diffusion for Korean firms. For instance, the inefficiency of developing customized solutions due to a lack of standardization in EV charging formats or AI-based medical imaging data standards must be eliminated.

Therefore, institutional bodies like the ‘Korea-ASEAN Smart Innovation Committee (KASII)’ must be utilized to promote standardization of EV charging infrastructure, ensure interoperability of smart city data platforms, and formulate joint guidelines on AI ethics and data protection (Ministry of Foreign Affairs, Korea, 2024). This regulatory harmony facilitates market access for Korean firms, activates intra-ASEAN trade and technology exchange, and serves as a strategic safeguard against policy uncertainty.

Technological Dimension: Strengthening Co-Development and Mutual Interdependence

Technological cooperation must be deepened through the Co-creation model. The focus must shift from merely transferring Korea's advanced technology to jointly researching and developing technology optimized for ASEAN's local environment and demand. Expanding joint R&D hubs—such as the K-AI Innovation Center in Vietnam and the K-Battery Tech Center in Indonesia (Korea Institute of Science and Technology Information, 2024)—is necessary. These hubs concentrate on developing localized solutions, such as climate-resilient solar modules and AI Natural Language Processing (NLP) models optimized for Southeast Asian languages. This provides the dual benefit of increasing the market suitability of Korean technology while strengthening ASEAN's technological internalization capacity.

Furthermore, introducing a 'Korea-ASEAN Smart Technology Joint Certification System' for technology developed through joint R&D increases the reliability of the technology, actively facilitates technology transactions between firms in both nations, and secures competitiveness in the global market (Korea Institute of Science and Technology, 2024). This institutional measure critically enhances mutual interdependence in core supply chain sectors, including back-end semiconductor processes and EV battery recycling technology.

Human Resource Dimension: Establishing a Joint Future Innovation Talent Ecosystem

The long-term sustainability of cooperation depends critically on securing Human Capital. To address the specialized talent shortage in advanced industries across ASEAN, a Future Innovation Talent Co-Talent

Ecosystem must be established by combining Korea's advanced education system with ASEAN's young, dynamic population.

This involves moving beyond current short-term training to implement joint Master's programs and technician co-certification systems in AI, EV, and smart city management. Linking institutions such as Korea's KAIST and POSTECH with major ASEAN technical universities to develop curricula and facilitate student exchange is highly effective for cultivating advanced human capital that is both theoretically sound and practically competent. The Korean Ministry of Education (2024) is tasked with linking these human resource development strategies with long-term ODA programs. Additionally, establishing an 'ASEAN–Korea Digital Talent Platform' is essential for connecting learners, firms, and educational institutions, thereby strengthening the local skill base and enabling Korean firms to efficiently recruit skilled personnel locally.

Industrial Dimension: Joint Design of New Global Value Chains

Ultimately, Korea-ASEAN cooperation must jointly design new value chains that align with global standards such as ESG, Digital Transformation, and Carbon Neutrality. This is a core strategy for elevating the industrial competitiveness of both regions amidst global supply chain realignment.

Key actions include completing the vertical integration model for the EV and battery supply chain, linking Indonesia's nickel resources and Korea's manufacturing technology with finished vehicle assembly in countries like Vietnam and Thailand (Bloomberg NEF, 2024). Furthermore, joint large-scale renewable energy projects through the 'K-ASEAN Renewable Energy Partnership (KAREP)' will accelerate both nations' carbon neutrality goals (Korea Energy Agency, 2024). This industrial approach, which also includes strengthening SME supply chain connectivity through the 'K-ASEAN Smart Industry Platform,' ensures that cooperation encompasses a comprehensive national cooperative system that integrates policy experience, technological capacity, human resources, and industrial linkage. When Korea and ASEAN pursue this strategy with the unified approach of the 'Triple Linkage Model' and 'Co-creation,' they will jointly emerge as the central axis of the 21st-century global supply chain realignment.

Chapter 5. Conclusion and Policy Implications

This study, entitled "The 2025 Korea-ASEAN Smart Innovation Policy Research," aimed to deeply analyze the smart city, eco-friendly mobility, AI/Robotics, renewable energy, and digital transformation policies of the South Korea and ASEAN. The analysis sought to identify mutually complementary cooperation strategies for the two regions amidst the profound macro-level shifts driven by the U.S.-China technology rivalry, the COVID-19 pandemic, and the climate crisis, which are restructuring global supply chains. The research concludes that Korea possesses strengths in technological capacity, infrastructure, and policy experience, while ASEAN holds significant potential in its rich resources, young demographics, and rapidly expanding market. This concluding chapter synthesizes the analyses from Chapter 1 through Chapter 4 to assert the imperative for the Korea-ASEAN relationship to evolve beyond mere economic ties toward a 'Smart Innovation Community' that integrates technology, human resources, and policy.

This overall conclusion is presented through three central themes. First is the strengthening of cooperation centred on global supply chains and industrial linkages, a strategy designed to create new value chains by combining the strengths of both regions. Second is the joint cultivation of human resource and technological ecosystems, which is necessary for securing the human capital required for cooperation sustainability. Third is policy and institutional harmonization, the mechanism for establishing the regulatory foundation essential to support collaboration. Through a thorough discussion of these three themes, the study derives concrete policy implications for how Korea and ASEAN can jointly address future challenges and achieve collective prosperity.

5.1. Global Supply Chain and Industrial Linkage-Centric Cooperation

The global supply chain is undergoing rapid realignment due to factors including the U.S.-China technology hegemony competition, the need for industrial resilience post-pandemic, and the demands of the energy transition and climate change response. The mutually complementary integration of technology, resources, and human resources in advanced industrial sectors is emerging as a core strategy for securing national competitiveness and ensuring the sustainability of industrial ecosystems. Cooperation between Korea and ASEAN must evolve beyond

simple technology transfer or investment to become an Industrial Value Chain Integration strategy, with its significance most pronounced in semiconductors, batteries (EV), AI/Robotics, smart cities, and renewable energy.

In the semiconductor industry, Korea possesses world-class competitiveness in design, process, and manufacturing technology. Conversely, ASEAN nations such as Malaysia and Thailand hold advantages in the back-end processes of assembly, testing, and packaging. The Ministry of Trade, Industry and Energy (2024) analysed that this mutually complementary combination—which links Korea's advanced front-end technology with ASEAN's efficient back-end infrastructure—can simultaneously enhance production efficiency by 20–25% and strengthen global export competitiveness, while dispersing geopolitical risk.

In the battery and EV industry, linking Korea's cathode/anode material technology and battery manufacturing expertise with Indonesia's nickel, lithium, and cobalt mineral resources can lead to increased EV production and achieve a maximum carbon reduction effect of 2 million tonnes. The joint venture established by LG Energy Solution and Hyundai Motor Group in Indonesia serves as a successful model of a 'resource-technology combined' supply chain. This secures a stable raw material supply chain for Korea and establishes Indonesia's foundation for growth as a core hub of the EV industry.

In the AI and Robotics sector, linking Korea's algorithms and hardware technology with the data resources and application industries of Vietnam and Singapore can enhance industrial productivity in smart manufacturing, healthcare, and logistics automation by 15–20%. ASEAN, particularly leveraging its rapidly growing data labeling industry, is emerging as an essential partner for optimizing Korean AI technology for local industry needs.

In the smart city sector, combining Korea's infrastructure integration management technology with the rapid urban growth base of ASEAN nations can improve urban management efficiency by 15% and enhance the public safety index. Joint projects applying Korea's smart city operational experience to locations like Hanoi, Vietnam, or Manila, the Philippines, contribute to solving urban challenges while fostering the creation of new industrial ecosystems.

In the renewable energy sector, combining Korea's solar and hydrogen technology with ASEAN's potential in wind, hydro, and biomass resources enables achieving over 30% renewable energy generation share. Linking Korea's Energy Storage System (ESS) and smart grid technology with ASEAN's abundant renewable energy resources strengthens energy security and contributes to achieving global carbon neutrality goals.

This integrated industrial and technological model concurrently establishes supply chain resilience, strengthens competitiveness, and lays the foundation for sustainable economic growth. Cooperation with Korea provides ASEAN nations with opportunities for technology localization and the development of high value-added industries, serving as a core factor that solidifies the mutually complementary partnership between the two regions.

5.2. Policy Implications and Future Strategy Recommendations

Korea-ASEAN smart innovation cooperation holds significant policy implications, thereby defining the future direction for the relationship between the two regions.

Strengthening Cooperation Governance

For Korea-ASEAN cooperation to evolve beyond episodic projects into a long-term partnership, the establishment of a standing governance body, such as the Korea-ASEAN Smart Innovation Initiative (KASII), is essential. This committee—encompassing government, industry, academia, and international organizations—must be utilized as a comprehensive cooperation framework responsible for policy coordination, joint project identification, conflict mediation, and performance evaluation. Furthermore, holding the 'Korea-ASEAN Smart Innovation Forum' annually is necessary to share a joint vision and serve as a platform for setting new cooperation agendas.

Human Resource Development and Technology Internalization

The local internalization of smart innovation technology is the most critical factor guaranteeing the sustainability of cooperation. Utilizing Korea's advanced education model, the implementation of Joint Master Programs and

Co-Certification Systems for Technicians is required. This contributes to cultivating local experts with the capacity for self-development and application of technology, moving beyond simple technology transfer. Expanding the role of the 'Korea-ASEAN Future Talent Development Center' is necessary to systematically cultivate specialized personnel in core sectors such as AI, EV, and smart city management.

Balanced Development and Inclusive Cooperation

Korea-ASEAN cooperation faces the risk of concentrating benefits in leading nations such as Singapore and Vietnam. To resolve this 'policy gap,' a differentiated cooperation model must be applied to nations at varying stages of development. For example, Official Development Assistance (ODA) must be leveraged for developing countries like Laos and Cambodia to support the establishment of smart infrastructure and basic technical human resource development, utilizing these efforts as a foundation for long-term industrial linkage. This inclusive approach is a vital strategy for promoting balanced development within ASEAN and broadly expanding cooperation with Korea.

Joint Establishment of Global Standards and Norms

Amid the deepening U.S.-China technology hegemony competition, Korea and ASEAN must proactively engage in 'Tech Diplomacy' by jointly establishing global standards and norms in the smart innovation sector. Joint research and policy coordination on EV battery standards, AI ethics guidelines, and smart city data sharing norms are essential for both nations to play a leading role in the global technological order. This presents a new technological paradigm combining Korean technology and the ASEAN market, helping both nations secure status as 'Co-architects' rather than mere participants in the global supply chain.

ESG and Sustainability-Centric Joint Projects

Climate crisis response is now a prerequisite for all industries. Korea and ASEAN must integrate ESG (Environmental, Social, and Governance) factors into renewable energy, EV, and smart city projects to construct a sustainable cooperation model. The establishment of a 'Korea-ASEAN Green Investment Fund' is needed to jointly secure necessary capital for eco-friendly infrastructure such as solar power, ESS, and smart grids, actively encouraging private sector participation. This cooperation not only contributes to both nations achieving the joint

goal of carbon neutrality but also serves as a critical driver for creating new business opportunities in the global ESG market.

Overall, Korea-ASEAN smart innovation cooperation transcends simple economic relations, representing an essential strategic choice for the stable growth and prosperity of both regions amidst a complex global environment. This cooperation must evolve into a comprehensive partnership integrating technology, human resources, policy, and industry. When these efforts come to fruition, Korea and ASEAN will jointly emerge as the central axis of the 21st-century global innovation era.

5.2.1. Policy and Institutional Harmonization

The sustainability of cooperation between Korea and ASEAN necessitates the essential implementation of Policy Harmonization. The successful realization of technological innovation and industrial linkage requires the stable establishment of supporting legal and institutional frameworks. This approach is a critical strategy that extends beyond mere technology transfer, serving to elevate the efficiency and predictability of the collaborative relationship.

Firstly, Technological Standardization is required. In advanced industrial sectors such as smart cities, AI/Robotics, EV/Batteries, and renewable energy, standardization is a core factor that simultaneously strengthens long-term industrial competitiveness and supply chain efficiency. For instance, variance in EV charging standards or smart city data communication protocols across different ASEAN nations compels Korean enterprises to undertake extensive, costly localization efforts, acting as a major impediment to technological diffusion. Therefore, a Joint Standardization Consultative Body, involving both governments and the private sector, must be established to jointly formulate technical standards applicable across the ASEAN region. This effort not only provides a strategic advantage for Korean technology to become the de facto standard in the ASEAN market but also actively promotes the technological internalization of ASEAN nations.

Secondly, Regulatory Alignment constitutes another important element. Regulations concerning data utilization, cybersecurity, Intellectual Property (IP) protection, and industrial safety vary considerably among ASEAN nations.

Cooperation with Korea necessitates a strategy for regulatory integration and alignment. Regulations concerning personal data protection and ethical issues arising from the use of AI technology are particularly critical challenges for bilateral cooperation. Sharing Korea's advanced data governance and IP protection frameworks with ASEAN nations and working toward their alignment with local legal frameworks is essential. This establishes the institutional foundation that allows firms from both regions to invest and collaborate within a stable, predictable environment.

Thirdly, the foundation for cooperation can be strengthened through Financial and Investment Coordination. The efficient mobilization of capital for cooperation projects must be pursued through joint funding mechanisms, Public-Private Partnership (PPP) projects, and tax incentives. For example, establishing a 'Korea-ASEAN Smart Innovation Investment Fund' supports the necessary initial capital for large-scale projects, such as EV charging infrastructure and smart city construction, while actively inducing private sector participation. This contributes to enhancing the financial sustainability of projects and reducing investment risk for Korean enterprises.

Lastly, policy coordination that incorporates Sustainability guarantees long-term stability in cooperation. Jointly pursuing policies aligned with global standards—such as ESG management, achieving carbon reduction targets, and applying eco-friendly technologies—is critical. This strategy reinforces the international leadership of both nations in responding to global climate change and plays a significant role in creating new business opportunities within the green industry sector. Through this policy and institutional harmonization, Korea and ASEAN can establish a long-term policy cooperation model, moving beyond short-term projects to secure policy stability and predictability.

5.2.2. Evaluation of ASEAN Countries' Smart Innovation Policies and Implications for Korea's Cooperation Strategy

This research systematically analyzed the smart innovation policies of individual ASEAN member states, identifying each country's strengths and limitations, and deriving specific implications for cooperation with Korea.

Thailand: Thailand achieved meaningful progress in economic development and technological industry promotion through the 'Thailand 4.0' policy, leading the smart city and EV sectors. However, it harbors structural limitations,

including the concentration of policy benefits in metropolitan areas, a shortage of specialized personnel, regulatory gaps, and a lack of data standardization. Cooperation between Korea and Thailand holds strategic significance for mutually complementary technology transfer, industrial linkage, and human resource development in the EV, AI, and renewable energy sectors. Korea's experience in integrated smart city platform operation can contribute to resolving Thailand's regional disparities and promoting industrial advancement (ASEAN Secretariat, 2024).

Malaysia: Malaysia, centred on the 'MyDigital Blueprint,' has achieved smart innovation successes in metropolitan areas and specific industries. Yet, persistent issues include nationwide imbalance, shortages of specialized personnel, regulatory framework deficiencies, and a lack of data standardization. Limitations are pronounced in the EV, AI/Robotics, and renewable energy sectors. Cooperation with Korea is strategically significant in terms of policy experience sharing, technology transfer, human resource development, and industrial linkages (Korea Institute for Industrial Economics & Trade, 2023). Collaboration, particularly in the EV, AI/Robotics, renewable energy, and smart city integrated platform sectors, can generate economic synergy.

Philippines: The Philippines' smart innovation policies have generated outcomes in Manila and specific industries, but they face structural constraints from regional disparities, shortages of specialized personnel, regulatory framework inadequacies, and lack of data standardization. Limitations are acute in the EV, AI/Robotics, and renewable energy sectors, necessitating considerable time for nationwide diffusion. Cooperation with Korea holds strategic importance in policy experience sharing, technology transfer, professional human resource development, and industrial linkages. Korea's smart city operational expertise and digital infrastructure development technology can effectively contribute to resolving the Philippines' urban challenges (MOTIE, 2024).

Indonesia: Indonesia, as the largest economy in Southeast Asia, has achieved success in metropolitan areas and certain industries through 'Making Indonesia 4.0'. However, it is constrained by structural limitations, including archipelagic regional imbalance, shortages of specialized personnel, inadequate regulatory frameworks, and lack of data standardization. Limitations are evident in the EV, AI/Robotics, renewable energy, and smart city integrated platform sectors, requiring significant time for nationwide diffusion. Cooperation with Korea and Indonesia holds strategic importance in policy experience sharing, technology transfer, professional human resource development, and industrial linkages. Specifically, the cooperation model combining Korea's EV battery technology with

Indonesia's abundant nickel resources plays a core role in enhancing global supply chain stability (UN ESCAP, 2023).

Singapore: Singapore achieved high smart innovation performance based on its limited geographical space and highly organized administrative system. However, challenges include high-cost infrastructure investment, securing specialized personnel, data standardization, and expanding private sector participation. Cooperation with Korea offers mutually complementary benefits in policy experience, advanced technology, industrial capacity, and human resource development. Amid global supply chain realignment, this collaboration holds strategic significance in connecting the EV, AI/Robotics, renewable energy, and smart city industrial ecosystems (ASEAN Secretariat, 2024).

Vietnam: Vietnam achieved substantial success driven by rapid urbanization, industrial development, and digitalization. However, structural challenges persist, including a nationwide policy gap, shortages of specialized personnel, inadequate data standardization, and limitations in infrastructure investment. Cooperation with Korea can create mutually complementary value in policy experience, advanced technology, professional human resource development, and industrial linkages. The recent expression of political commitment through high-level visits serves as a strategic momentum for advancing cooperation (Korea Institute for Industrial Economics & Trade, 2023).

Laos and Cambodia: Laos and Cambodia achieved meaningful smart innovation outcomes despite limited national resources and infrastructure. Nevertheless, nationwide policy gaps, shortages of specialized personnel, inadequate data standardization, and limitations in EV and renewable energy infrastructure investment remain challenges. Cooperation with Korea can generate mutually complementary synergy in smart city operations, AI/Robotics technology, EV and renewable energy technology transfer, and digital infrastructure development.

Myanmar: Myanmar recorded limited smart innovation achievements before the conflict, but policy execution has been practically suspended since the conflict began. Should political stabilization occur in the future, cooperation

with Korea can play a critical role in the restoration and resumption of smart innovation policies. A phased approach is necessary to rebuild policy and industrial foundations through limited regional pilot projects.

5.2.3. Joint Cultivation of Human Resources and Technological Ecosystems

Cooperation in the smart innovation sector inherently faces limitations if confined solely to technology transfer; for a successful partnership, it must be intrinsically linked with human resources and educational frameworks. As the ultimate agents of technology development, application, and maintenance are people, the collaboration between Korea and ASEAN necessitates a comprehensive strategic approach that organically connects technology, human resources, and the industrial ecosystem. This approach is fundamental to bridging the technological gap between the two regions and jointly building sustainable innovation capacity.

Cultivating High-Level Human Resources through Joint Master's and Doctoral Programs

The advancement of high-tech industries is impossible without a highly skilled workforce. Korea and ASEAN must design joint educational programs in key areas—AI, robotics, smart city management, and eco-friendly energy—to provide advanced education to students and researchers from both sides, thereby cultivating personnel immediately deployable in industrial settings. These joint programs can be operated through the following mechanisms:

- **Joint Curriculum Development:** Practical curricula must be co-developed, integrating Korea's advanced technical education experience with ASEAN's specific local industrial demands. For example, the establishment of a joint Master's program in AI and Data Science between the Korea Advanced Institute of Science and Technology (KAIST) and Hanoi University of Science and Technology (HUST) can facilitate projects that combine AI modeling technology with Vietnam's large-scale industrial data.
- **Cross-Registration and Research Collaboration:** Students should be able to attend classes across both countries' campuses and conduct research projects under joint supervision, thereby cultivating global research competence (KAIST, 2024). This process extends beyond mere knowledge transfer, contributing to the establishment of research networks and deepening cultural understanding between researchers.

- **Scholarship and Financial Support:** Utilizing the Korea-ASEAN cooperation fund to provide scholarships and living allowances to students participating in these joint programs offers opportunities for excellent talent to pursue advanced technology studies without financial burden. The Ministry of Education, Korea (2024) is pursuing plans to expand such talent cultivation programs as part of long-term Official Development Assistance (ODA).

Strengthening Field Application Capacity through Technician Certification Systems

The successful localization of advanced technology within local industries requires a pool of skilled technicians capable of understanding and applying the technology in real-world settings. To this end, the introduction of technician certification systems, such as the 'K-Tech ASEAN Certification,' is essential for evaluating field application capabilities and promoting the acquisition of standardized technical skills.

- **Joint Certification Programs:** Collaborative efforts between Korea's accredited technical training institutions (e.g., Korea University of Technology and Education) and ASEAN vocational training institutions should develop joint certification programs for specific technical fields, including EV charging infrastructure installation and maintenance, smart factory robot operation, and AI-based data analysis.
- **Standardized Evaluation Frameworks:** The technical competence of technicians must be objectively verified through evaluation criteria and examination systems jointly developed by both nations. Technicians receiving this certification gain professional recognition in both countries, enhancing their employment prospects and industrial mobility (Korea Chamber of Commerce and Industry, 2024).

This certification system functions as a 'win-win' strategy, accelerating the diffusion of Korean technology across ASEAN while elevating the technical proficiency of the ASEAN workforce, assisting in the transition toward high value-added industries.

Field-Based Learning via R&D Internships and Exchange Programs

Practical experience in actual industrial settings is a crucial determinant of the quality of human resource development, complementing theoretical education. Students and researchers should be allowed to participate in joint R&D projects and acquire local technical skills within ASEAN through R&D internships and exchange programs.

- **Industry-Academia Linked Internships:** Korean large corporations (Samsung Electronics, Hyundai Motor) and startups should offer internships to university students and researchers from ASEAN. These participants can gain practical experience in Korea's advanced technology environment and apply this knowledge upon returning to their home countries. For example, learning EV battery production processes at a Hyundai Motor facility in Indonesia and participating in a project to develop localized technology based on that knowledge.
- **Field-Centric Research Programs:** Korean national research institutes (ETRI, KIER) and ASEAN research organizations should jointly operate field-centric research programs. This includes co-developing smart agriculture solutions for Vietnam's Mekong Delta region or involving Korean researchers in Philippine hydropower plant modernization projects to share technical know-how. Such programs simultaneously transfer technology, cultivate locally adapted personnel, and generate practical outcomes contributing to real problem-solving (Korea Institute of Energy Research, 2024).

Establishing an Innovation Ecosystem through Joint Startup Support

Beyond human resource cultivation, supporting individuals with innovative ideas to create new value through entrepreneurship is critical. Korea-ASEAN joint startup support promotes the establishment of new industries based on innovative technologies and expands market validation projects within ASEAN.

- **'Korea-ASEAN Joint Startup Incubation Program':** Collaboration between Korean technology startup incubators (accelerators, venture capital firms) and ASEAN innovation agencies should lead to joint programs for identifying and nurturing promising startups. These programs provide technical mentorship, funding support, and consulting for market entry in both countries. An example is a Korean AI startup

collaborating with a Vietnamese smart agriculture startup to co-develop a product and jointly enter the ASEAN market.

- **Expansion of Market Validation Projects:** Market validation projects, which allow Korean firms to test their innovative technologies directly in ASEAN markets, must be expanded. The Korean government should reinforce financial and administrative support for these projects to enhance technology market suitability and facilitate the identification of local partners. This moves beyond simple technology transfer to build a sustainable technology and industrial ecosystem, creating a virtuous cycle that simultaneously fosters high-level local talent and industrial linkage.

This joint human resource and technological ecosystem cultivation strategy is critical for transitioning the Korea-ASEAN relationship from a vertical structure of 'technology provider–technology recipient' to a horizontal partnership focused on 'jointly solving common problems and building the future together.' This fundamentally strengthens the technological self-reliance of both regions and solidifies the foundation for a long-term partnership.

5.2.4. Joint Project Models

Joint projects are the essential execution mechanism for Korea-ASEAN smart innovation cooperation, applicable across all key sectors: smart cities, battery/EV, AI/Robotics, and renewable energy. These projects focus on combining the strengths of both nations to solve real-world problems and create new value, moving beyond mere technology delivery. The joint project model is a strategic approach capable of achieving both short-term tangible results and long-term technological internalization, maximizing success through the active participation of governments, industry, and academia in each country.

Smart City Demonstration Projects

Smart city demonstration projects aim to enhance urban operational efficiency and improve the quality of citizen life by combining Korea's advanced infrastructure management technology with the real-world urban challenges and data of the ASEAN region. This approach provides integrated solutions for sustainable urban development, extending beyond simple technology adoption.

- **Integrated Solutions for Traffic Management and Urban Safety:** Major metropolitan areas like Hanoi, Vietnam, and Manila, the Philippines, face severe traffic congestion challenges. Korea can transfer AI-based traffic control systems, intelligent traffic lights, and real-time traffic information platform technology to these cities for joint demonstration projects. This system analyzes traffic data to optimize flow, contributing to a 20% or greater reduction in peak-hour traffic congestion. Furthermore, integrated control systems utilizing smart CCTVs and AI-based crime prediction models effectively enhance urban security and reduce crime rates. Korea's smart city models, such as Busan Eco Delta City, serve as important examples demonstrating the application of these integrated solutions in urban management.
- **Energy and Environmental Management Systems:** Many ASEAN cities face severe air pollution and energy efficiency challenges due to rapid industrialization. Korea can provide IoT sensor-based air quality monitoring systems and smart energy management platforms to collect and analyze urban environmental data in real-time. For instance, a project in Thailand's Chonburi Smart Industrial Complex can optimize energy consumption within the industrial zone and reduce greenhouse gas emissions by implementing Korea's energy management system. Such cooperation contributes to the environmental goal achievement of both nations and establishes a foundation for new eco-friendly industrial ecosystems (Ministry of Land, Infrastructure and Transport, Korea, 2024).

EV and Battery Supply Chain Projects

EV and battery supply chain projects aim to establish a core value chain for the global EV market by combining Korea's technological capacity with ASEAN's resource and production capabilities. This model seeks Vertical Integration across the entire supply chain, spanning from raw material mining to the final deployment of EVs.

- **Raw Material-Battery-EV Integrated Value Chain Establishment:** Indonesia is a core mineral resource country, holding 22% of the world's nickel reserves. Korean firms such as LG Energy Solution and Hyundai Motor Group are collaborating with Indonesia to establish an integrated supply chain: mining raw materials, locally processing them into battery materials, and producing final battery cells and finished vehicles. This model is critical for minimizing raw material supply uncertainty and establishing a stable EV production base. According to BloombergNEF (2024), such integrated models can generate unique competitive advantages in the global EV market.

- **Charging Infrastructure and Battery Recycling Projects:** Stable charging infrastructure development is essential for expanding EV adoption. Korea can transfer EV charger technology and station operation know-how to ASEAN nations like Vietnam and Thailand, promoting the expansion of charging networks through Public-Private Partnership (PPP) models. Furthermore, sharing end-of-life battery recycling technology is critical for establishing a resource circulation economy and ensuring environmental sustainability. Cooperation in this area can contribute to both increased EV production and a carbon reduction effect of up to 2 million tonnes (Korea Energy Economics Institute, 2024).

AI and Robotics Application Projects

AI/Robotics application projects aim to enhance productivity and efficiency across smart manufacturing, healthcare, and logistics automation by combining Korea's algorithms and hardware technology with ASEAN's data-driven industries.

- **Joint Smart Factory Solution Development:** Nations with developed manufacturing sectors, such as Vietnam and Thailand, show high interest in adopting Korea's AI-based smart factory solutions. Korea can pursue joint projects to apply AI-based process optimization, robotic automation, and predictive maintenance technologies to these countries' factories. This collaboration will enhance manufacturing productivity by 15–20% and contribute to the high value-addition of ASEAN industries.
- **Localization of Healthcare and Agricultural AI Technology:** Many regions in ASEAN suffer from low access to healthcare services or low agricultural productivity. Korea's medical AI technology (e.g., AI-based medical image analysis, telemedicine systems) can be localized and deployed in the healthcare systems of countries like the Philippines and Indonesia. Furthermore, cooperation can introduce AI-based smart agriculture systems (e.g., drone-utilized crop management, data-driven irrigation systems) to Cambodia and Laos, enhancing agricultural productivity and strengthening food security.

Renewable Energy Joint Development Projects

Renewable energy joint development projects aim for carbon reduction and energy independence expansion by utilizing solar and hydrogen technology and linking them with ASEAN countries' potential in wind, hydro, and biomass.

- **Large-Scale Renewable Energy Power Plant Construction:** Joint projects can be pursued where Korean firms construct and operate power plants, utilizing the abundant offshore wind and solar resources of Vietnam and the Philippines. Collaboration is also vital in applying Korea's smart grid technology to hydropower plant modernization in the Philippines and Laos, thereby increasing power efficiency and stability. According to the International Energy Agency (IEA, 2024), such cooperation can contribute to elevating ASEAN's renewable energy generation share to over 30%.
- **Hydrogen Energy and ESS Technology Cooperation:** Korea possesses world-class competitiveness in hydrogen energy and ESS technology. Applying this technology to ASEAN's renewable energy power plants can stabilize the power grid by mitigating the intermittency challenge of renewables. Establishing a 'Korea-ASEAN Green Investment Fund' is required to finance these projects and induce private investment.

These joint projects are strategic models capable of achieving both short-term results and long-term goals. They are instrumental in strengthening ASEAN's smart innovation capacity and solidifying mutually interdependent relations with Korea, ultimately serving as the core engine for both regions to achieve shared sustainable growth objectives.

5.2.5. Conclusion: The Integrated Smart Innovation Community

The study, "The 2025 Korea-ASEAN Smart Innovation Policy Research," deeply analysed the smart city, eco-friendly mobility, AI/Robotics, renewable energy, and digital transformation policies of Korea and ASEAN. It sought mutually complementary cooperation strategies within the context of global supply chain realignment driven by the U.S.-China technology rivalry, the COVID-19 pandemic, and the climate crisis. The findings confirm that Korea possesses strengths in technology, infrastructure, and policy experience, while ASEAN holds potential in its rich resources, young demographics, and rapidly expanding markets. This concluding chapter synthesizes all preceding analyses (Chapters 1 through 4) to assert the final recommendation: the relationship between Korea

and ASEAN must evolve beyond mere economic ties to form a 'Smart Innovation Community' that integrates technology, human resources, and policy.

Overall, Korea-ASEAN smart innovation cooperation is highly likely to succeed only when policy experience, technological capacity, human resources, and industrial linkages are considered simultaneously. Mutually complementary cooperation is an imperative amid global supply chain realignment. Korea provides technology-intensive innovation capacity and global standard-setting experience, while ASEAN provides its abundant human resources, vast market access, and core resource base. By combining these, both regions can set the joint objective of establishing a sustainable growth engine for East Asia.

The cooperation strategy to achieve this joint objective is presented as follows: First, Integrated Policy Linkage is essential, requiring the mutually complementary integration of Korea's smart innovation policy models with ASEAN's national strategies. Linking Korea's 'Digital New Deal' and 'Green New Deal' policy experiences with ASEAN's 'ASCN' (Smart City Network) and 'ADM 2025' (Digital Masterplan) enhances policy consistency and efficiency. This goes beyond simple information sharing to secure 'Policy Synchronicity,' where the policies of both sides interact to maximize synergy.

Second, the Industrial and Technological Value Chains must be Linked. In core advanced industrial sectors—semiconductors, batteries, AI/Robotics, smart cities, and renewable energy—value chains integrating Korea's technology with ASEAN's production and resource capacity must be established. For instance, the model of vertically integrating the EV battery supply chain by combining Korea's battery manufacturing technology with Indonesia's nickel resources, then linking this supply chain with finished vehicle production hubs like Vietnam and Thailand, will play a decisive role in strengthening global supply chain stability and resilience. This cooperation prioritizes the creation of a joint industrial ecosystem integrating technology, human resources, and resources.

Third, the Human Resource, Education, and R&D Ecosystems must be Jointly Cultivated. To ensure the local internalization of smart innovation technology and secure sustainable industrial talent, joint Master's/Doctoral programs, technician co-certification systems, and internship programs must be operated. Introducing Korea's

advanced technical education model to ASEAN and fostering an environment for joint research participation by youth from both nations is necessary to expand technical exchange and networks. This critically strengthens ASEAN's technological self-reliance capacity and establishes an excellent human capital base for Korean firms' local expansion.

Fourth, Demonstration Projects Based on Joint Projects must be actively pursued. Stepwise scalable demonstration projects in smart city, AI/Robotics, EV/Battery, and renewable energy sectors must be implemented to generate tangible results rather than relying solely on theoretical cooperation. For example, conducting a demonstration project applying Korea's smart city integrated platform to a specific ASEAN city to resolve traffic, energy, and safety issues, and then using that success model for regional diffusion. This approach simultaneously yields short-term results and establishes the foundation for long-term technology internalization and industrial linkage.

This overall approach transcends simple technology transfer, serving as the foundation for forming a Korea-ASEAN Smart Innovation Community and realizing the 'Triple Linkage Model' of policy, industry, and technology. Over the next decade, this community will be positioned as a core platform that simultaneously strengthens innovation and industrial competitiveness, sustainability, and economic stability across the East Asia region. This represents an essential strategic choice for the future prosperity of both parties and a significant milestone for reinforcing their identity as a community.

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