HARVARD Kennedy School
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for Science and International Affairs

Critical and Emerging Technologies Index 2025: South Korea Report

Executive Summary

South Korea is solidifying its position as a key global player in emerging technologies, with its **overall standing of 5th** in these emerging technologies surpassing its 2023 GDP ranking of 14th globally.[1] This achievement is driven by cutting-edge ICT infrastructure, world-class internet speeds, the government's digital transformation efforts, leading tech companies, and a tech-savvy population.[2]

All five sectors were designated among South Korea's 12 national strategic technologies in 2022. This was followed by the enactment of the Special Act on Fostering National Strategic Technologies in 2023 and the development of a cross-ministerial Basic Plan in 2024. Under the First Basic Plan (2024-2028), the government allocated KRW 6.8 trillion (approximately USD 4.9 billion) in 2025 for targeted R&D across the 12 strategic technologies, with a strong emphasis on AI, semicon, biotech, and quantum technologies.

However, key challenges remain. To stay competitive in an increasingly global landscape, **policy and public funding support** must be both sustained and strengthened. **Talent shortages**–exacerbated by a shrinking population and the growing tendency of STEM students to pursue careers in medicine–are especially acute in semiconductor, AI, biotech, and quantum technologies. The government must remain vigilant in advancing **regulatory reform**, given that global competitors are rapidly easing regulatory constraints. The space sector requires further commercialization. Targeted government support is essential to help companies scale globally and to foster international partnerships, especially in AI and biotech.

1 World Bank, "GDP Ranking," World Bank Group Data Catalog, Dec 18, 2024, https://datacatalog.worldbank.org/search/dataset/0038130.

2 International Trade Administration, "Korea - Digital Economy," Country Commercial Guide, September 19, 2024, https://www.trade.gov/country-commercial-guides/korea-digital-economy.

General Overview

As of 2023, South Korea ranks **5th overall**, with its strongest performance in **semiconductors (5th)**, followed by high rankings in **AI (9th), quantum technologies (12th),** and **biotech (10th)**, while its ranking in **space technologies (13th)** remains relatively low.

The following section examines how the Korean government is strategically fostering the development of these technologies and how Korean companies are adapting to the evolving environment, while addressing the distinct challenges within each sector. Although the data focuses on developments only through 2023, the following section includes more recent updates.

Artificial Intelligence

Status Quo

South Korea has achieved **one of the fastest advancements in AI technology** among major countries from 2018 to 2022.[3] Korea's competitiveness in digital technologies, combined with widespread recognition of AI's importance across government and major companies, strong ICT infrastructure, and an AI-friendly user base, has laid a solid foundation for the growth of its AI ecosystem.

In a recent survey, 55% of Korean respondents reported having used an AI application in the past twelve months, surpassing the global average of 48% (U.S. 29%, Japan 28%, Italy 43%, UAE 71%).[4] Revenues of promising AI application companies have been on the rise. Several sectors have shown particularly strong growth in 2023 compared to 2022, including healthcare (+55.9%), content and education (+33.3%), and mobility and transportation (+25.9%).[5]

In 2024, Korea enacted a **framework act on AI** as the world's second country after the EU, by passing the "Framework Act on the Advancement of Artificial Intelligence and the Establishment of a Foundation for Trust." The government will invest KRW 1.5 trillion (USD 1 billion) in supporting the AI industry in 2025, including the establishment of an AI computing center and the development of artificial general intelligence (AGI).[6]

However, low and declining levels of private investment[7], technology gaps in generative AI, relatively small domestic market, and a limited AI workforce remain key challenges.

3 Institute of Information and Communications Technology Planning and Evaluation (IITP), "2022 ICT Technology Level Survey and Technology Competitiveness Analysis Report," IITP, March 4, 2024, https://iitp.kr/kr/1/knowledge/openReference/view.it?ArticleIdx=6779&count=true&page=1.

4 Ipsos, "Google / Ipsos Multi-Country AI Survey 2024," Google / Ipsos, January 2025, https://www.ipsos.com/sites/default/files/ct/news/documents/2025-01/Google%20Ipsos%20Multi%20Country%20AI%20Study%20Topline%20for%202025%20.pdf.

5 Hyun-jin Lee, "2024 Annual Report on Global Trends in Artificial Intelligence," Korea Development Institute (KDI), May 2025. https://eiec.kdi.re.kr/policy/domesticView.do?ac=0000190894.

6 Sung-hyun Kim, "AI Policy Shaken by President Yoon's Impeachment; Tech Industry Shifts Focus to Presidential Candidates," *Aju Business Daily*, April 6, 2025, https://www.ajunews.com/view/20250406152218091.

7 Seungjoo Lee, "Even in Spring, Startups Remain in a Slump—Number of Investments Drops 24% in Q1," *Newsis*, April 4, 2025, https://www.newsis.com/view/NISX20250403_0003126030. Joe White and Serena Cesareo, "The Global AI Index", *Tortoise Media*, September 19, 2024, https://www.tortoisemedia.com/data/global-ai#rankings.

Recommendations

- **Continue investing in and providing policy support for the establishment of the National AI Computing Center** by 2030. This center is crucial in expanding access to GPU resources. Ensure strategic allocation of GPUs while maintaining accessibility for startups and SMEs.
- **Expand tax incentives to encourage private investment and improve access to data**, especially in light of the low and declining levels of private investment. In particular, strengthen support for generative AI development and prioritize assistance for startups and SMEs.
- To address the significant talent gap which reached 7,841 in 2022[8] and the overwhelming national preference for medical careers, **reform middle and high school education to strengthen AI learning from an early age**. Establish AI-focused academic tracks within STEM-specialized high schools that offer pathways to top universities and major companies.

Biotechnologies

Status Quo

South Korea has made **continuous and remarkable progress** in biotechnology, driven by **sustained public sector R&D investment and private sector-led innovation.**[9] Recognizing biotechnology as a key future growth engine, the government aims to position Korea among the world's top five advanced biotech nations in 2035. In 2022, advanced biotechnology was designated as one of three game-changing sectors, alongside AI·semiconductors and quantum technologies among 12 national strategic technologies. Reflecting this priority, R&D investment in advanced biotechnology reached KRW 2.12 trillion (USD 1.5 billion) in 2025, representing a 19.1% increase from 2024.[10]

To strengthen governance across ministries responsible for science, health, and industry and to enhance public-private coordination, **the National Bio Committee** was launched in January 2025 as a presidential advisory body. The committee brings together relevant ministers, representatives from major biotech firms, and experts from academia and research institutes. Its main proposals include accelerating new drug development, creating mega funds, expanding production capacity, and cultivating professionals. Recent government initiatives also aim to strengthen collaboration among bioclusters, improve data connectivity within the national bio-data platform, and regularly ease regulatory burdens.

Meanwhile, leading biotech firms such as Samsung Biologics and Celltrion are at the forefront of the innovation. These firms possess core technologies and are advancing biotech frontiers by expanding biopharmaceutical manufacturing capacity and developing biosimilars.

8 KIAT, "KiAT's Top 10 Promising Industries for 2024," KIAT, April 17, 2024, https://www.kiat.or.kr/front/board/boardContentsView.do?board_id=71&contents_id=de1bcb256cc54433bf221a10a8ec1a88&MenuId=878cb9b6d5ec41bf914ad5c0f590ed14.

9 Korea Trade-Investment Promotion Agency (KOTRA), "Korea's Biotech Industry, Emerging as a Global Manufacturing Hub of Cutting-Edge Biotechnology," Invest Korea, June 2, 2023, https://www.investkorea.org/ik-en/bbs/i-308/detail.do?ntt_sn=490784.

10 Presidential Advisory Council on Science and Technology, "2026 National R&D Investment Direction and Criteria (Draft)," Presidential Advisory Council on Science and Technology, March 13, 2025, https://www.pacst.go.kr/jsp/council/councilArchiveView.jsp?archive_id=1189.

Recommendations

- To address the fragmented nature of the current biotech landscape and strengthen the R&D ecosystem, **accelerate the development of a comprehensive national bio-data platform** that integrates data from the government, the industry, hospitals, and research centers. This platform should encompass both traditional and advanced biotechnologies to foster innovation and collaboration.
- **Review and reform existing regulatory barriers, and expand public R&D** to accelerate the development and deployment of new drugs while easing burdens on biotech firms. Assess the current national regulations in comparison with international standards and the standards of leading nations.
- Given the modest 7.9% increase in graduate-level human resources in the sector from 2021 to 2022[11], **actively develop the workforce through funding** relevant programs at universities and research centers and establishing partnership programs that bridge academia and industry, both domestically and internationally–including with leading foreign research institutes.

Semiconductors

Status Quo

South Korea possesses a significant position globally, with **major companies** like Samsung Electronics and SK Hynix leading in the production of DRAM and High Bandwidth Memory (HBM) chips. Beyond memory production, South Korea is among the few nations with a **comprehensive semiconductor value chain**, encompassing both DRAM manufacturing and foundry services. particularly in the memory semiconductor sector.

In 2023, Korea maintained its position as **the world's second-largest semiconductor producer** for the 11th consecutive year since 2013. Semiconductors remain one of Korea's leading export items, accounting for 15.6% of total exports in 2023. As a core pillar of the national economy and industry, the sector continues to drive Korea's technological and economic growth.[12]

However, Korea is now at a critical juncture, facing a technology gap amid **intensified global competition**–particularly due to significant governmental support and technological advancements of competitors, as well as trade barriers. Korea is also experiencing a decline in its system semiconductor market share, which stood at 3.1% in 2022[13], and suffering from a shortage of skilled personnels.

The government plans to invest approximately $6.3 billion in the semiconductor industry by 2025 to enhance the competitiveness of the entire industry ecosystem[14]. In February 2025, The National Assembly passed the so-called "K-Chips Act", expanding tax incentives for semiconductor companies.[15]

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11 Korea Institute for Advancement of Technology (KIAT), "2023 Analysis of the Supply and Demand of Industrial Technology Workforce," KIAT, https://www.kiat.or.kr/front/board/boardContentsView.do?contents_id=62f25db0e9fe43a9bae6dcccf313ac79&MenuId=5da1bd8b37ab46788b11421041dd8c74.

12 KOTRA, "Semiconductors," Invest Korea, Accessed April 14, 2025, https://www.investkorea.org/ik-en/bbs/i-308/detail.do?ntt_sn=490784.

13 KIAT, "2024 Industrial Technology Environment Outlook Report," KIAT, April 12, 2024, https://www.kiat.or.kr/front/board/boardContentsView.do?board_id=71&contents_id=8106438a71054885be7ace23db10e3ee&MenuId=878cb9b6d5ec41bf914ad5c0f590ed14.

14 Korea Policy Briefing, "Government to Invest KRW 8.8 Trillion to Be Invested In Semiconductor Industry by Next Year to Strengthen Ecosystem Competitiveness," Policy News, October 16, 2024, https://www.korea.kr/news/policyNewsView.do?newsId=148935134#policyNews.

15 Eun-jin Kim, "K-Chips Act Clears Major Legislative Hurdle, Enhancing Tax Incentives for Semiconductor Industry," *Business Korea,* February 18, 2025, https://www.businesskorea.co.kr/news/articleView.html?idxno=235649.

Recommendations

- **To accelerate the development of semiconductor clusters, the government should increase subsidies, as its competitors have done, and streamline regulations.** A stable manufacturing infrastructure will help the industry to secure investment more easily and build a stronger ecosystem.
- **Further strengthen R&D investment for startups developing AI semiconductors,** a field where South Korea remains comparatively underrepresented. In light of a recent case in which a Korean AI chip startup declined an acquisition offer from META, the government should foster an environment that supports and incentivizes innovation in the non-memory sector.
- **Develop and implement a comprehensive talent development and attraction strategy** to address the talent shortage, which reached 1,752 in 2021.[16] Support national champion companies in delivering relevant curricula at universities, and enhance incentives for foreign R&D professionals to work in and relocate to South Korea.

Space Technologies

Status Quo

South Korea has made remarkable progress in recent decades, marked by its **domestically developed three-stage launch vehicle** Nuri, also known as the Korea Space Launch Vehicle II (KSLV-II), which is capable of placing a 1.5-ton satellite into a 600 to 800 km solar synchronous orbit. It became the seventh country that can launch satellites into high orbits[17] and is now developing the larger KSLV-III. These achievements have been made possible through close collaboration with the nation's leading space companies, including Hanwha Aerospace and Korea Aerospace Industries (KAI). South Korea aims to send a spacecraft to the moon by 2032 and explore Mars by 2045. However, these advancements may not be fully reflected in this ranking, as the broad 'launch' indicator may overlook key differences in national capabilities.

The recent establishment of **Korea Aerospace Administration (KASA)** in 2024 underscores South Korea's ambition to accelerate space exploration and boost its space economy. KASA announced plans to invest KRW 806 billion (USD 580 million) in R&D in 2025–a more than 43% increase from 2024.[18] It is also allocating KRW 380 billion (USD 273 million) between 2024 and 2030 to develop three space industry clusters.[19]

Investment in military space projects has also surged in recent years, a development that may not be fully reflected in this report's data. Since 2023, the military has been implementing Project 425, with KRW 1.3 trillion (USD 936 million)[20] committed through 2025 to acquire five high-resolution military reconnaissance satellites to address North Korea's threats.

16 KIAT, "2024 Industrial Technology Environment Outlook Report," KIAT, April 12, 2024, https://www.kiat.or.kr/front/board/boardContentsView.do?board_id=71&contents_id=8106438a71054885be7ace23db10e3ee&MenuId=878cb9b6d5ec41bf914ad5c0f590ed14.

17 Robert S. Wilson and Nicholas J.Wood, "Country Brief - South Korea," Center for Space Policy and Strategy, August 2023, https://csps.aerospace.org/sites/default/files/2023-08/Wilson-Wood_SouthKorea_20230802.pdf.

18 Korea AeroSpace Administration (KASA), "Korea to Invest KRW 806.4 Billion in 2025 R&D Projects to Become a Top 5 Aerospace Power," press release, March 25, 2025, https://www.kasa.go.kr/prog/bbsArticle/BBSMSTR_000000000041/view.do?bbsId=BBSMSTR_000000000041&nttId=B0000000001475Sj3oS1.

19 KASA, "KASA Announces the 'Space Industry Cluster Tripartite System Construction Project (R&D),'" press release, September 11, 2024, https://www.kasa.go.kr/prog/bbsArticle/BBSMSTR_000000000041/view.do?bbsId=BBSMSTR_000000000041&nttId=B0000000000759Uq5vX6.

20 Jong-Yoon Lee, Jong-Yoon Lee, "South Korea Launches Its 3rd Reconnaissance Satellite to Monitor North Korea," *Financial News*, December 21, 2024, https://www.fnnews.com/news/202412201534445530.

Recommendations

- **Sustain long-term growth in government space R&D while diversifying the budget allocations**, which are currently heavily concentrated on reconnaissance satellites and launch vehicle development. As a second mover, Korea must heavily invest in flagship programs while broadening its spending to manage risks and stimulate the broader space industry.
- **Build a space industry ecosystem rooted in specialized clusters, with targeted financial support for both established firms and startups, and enabling policies to drive the commercialization of space technologies**. Encourage the regulated spin-off of space assets and technologies to maximize their economic impact.
- **Strengthen support for KASA, including increased and sustained funding**. Building on bipartisan support, the government should continue to reinforce KASA's institutional capacity, ensure a consistent upward trend in its funding, and empower the agency to serve as a control tower for the nation's space programs.
- **Continue actively engaging in international partnerships** and build upon its coalition with like-minded countries to uphold the safe and sustainable use of outer space.

Quantum Technologies

Status Quo

Korea is an emerging player with strong potential in quantum technologies. Quantum technologies were designated as one of three game-changing sectors among 12 national strategic technologies, along with AI·semiconductors, and biotechnology.

Major conglomerates, including Samsung Electronics and Hyundai, have been investing in quantum R&D and applications, signaling growing rising interest from the private sector and recognizing quantum as a multiplier in the broader ICT landscape.

Although Korea was relatively late in adopting a comprehensive quantum development strategy, the government has taken **active steps** since launching the Quantum R&D Investment Strategy in 2021[21] and implementing the "Quantum Science and Industry Promotion Act" in 2024. To oversee and coordinate national quantum strategies and initiatives, the Quantum Strategy Council was established in 2025 under the Prime Minister's Office. R&D investment in quantum technologies reached KRW 200 billion (USD 144 million) in 2025, marking an increase of over 50% in 2025 compared to 2024.[22] While the number of essential human resources across industry, academia, and research grew by 29.9% during the same period, it remained limited, totaling just 499 in 2023.[23]

21 Korea Institute of Science and Technology (KIST), "Strategic Directions for AI Development," *KIST Opinion*, August 2023, https://www.kist.re.kr/ko/news/kist-opinion.do?mode=view&articleNo=13066.

22 Hyung-jun Kim, "Quantum Technology Spotlighted by the Drama 'The Three-Body Problem'... A New Growth Engine for Semiconductor Powerhouse South Korea," Korea Institute of Science and Technology (KIST), https://www.pacst.go.kr/jsp/council/councilArchiveView.jsp?archive_id=1189&

23 Ministry of Science and ICT, "MSIT Unveils First Master Plan for Developing Critical and Emerging Technologies (2024-2028): A Blueprint for National S&T Sovereignty," press release, August 26, 2024, https://www.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=4&bbsSeqNo=42&nttSeqNo=1034.

Recommendations

- **Accelerate the development of quantum clusters**. Drawing from the precedents set by bio clusters, concentrate efforts on a select few rather than dispersing resources. **Strengthen collaborative ecosystems among industry, academia, and research institutes** within these clusters.
- **Maintain increased R&D investment in key quantum technologies** including quantum computing, communications and sensing, where South Korea faces a technology gap compared to leading nations.
- **Expand academic exchange programs with universities in leading nations** in quantum technologies. **Increase public funding and support mechanisms to attract top foreign quantum researchers** to conduct research in Korea.

Governance Structure

The Presidential Advisory Council on Science and Technology (PACST), established in 1989, set Korea's mid- to long-term policy directions for science and technology, including in emerging fields. Chaired by the President and composed of the relevant ministers and civilian experts, the Council designated 12 critical emerging technologies and 50 specific priority technologies in 2022. It also plays a key role in coordinating the government's annual cross-ministerial R&D budgets.

"The Special Act on National Strategic Technologies", enacted in 2023, provides the legal foundation for policies supporting national strategic technologies. Based on this act, the government establishes a five-year Basic Plan.

The Ministry of Science and ICT (MSIT) operates the **Science, Technology, and Innovation Office (STI Office)**, which supports MSIT's coordination role across the government. The STI Office coordinates budgets, and oversees the monitoring and evaluation of policy implementation. Relevant ministries submit their annual and mid-term R&D action plans to the STI Office for review.[24]

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She is a Korean diplomat with six years of experience, specializing in technology and space security diplomacy. At the Disarmament and Non-proliferation Division of the Korean Ministry of Foreign Ministry, she contributed to Korea's space security policy and international cooperation efforts. She also played a key role in organizing the 21st ROK-UN Joint Conference on Disarmament and Non-Proliferation Issues in 2022, which focused on space security.

During her posting at the Korean Embassy in France, she led Korea-France cooperation on United Nations

24 OECD, "Challenges and Opportunities of Mission-Oriented Innovation Policy in Korea," *OECD Science, Technology and Industry Policy Papers*, OECD Publishing, Paris, March 3, 2025, https://www.oecd.org/en/publications/challenges-and-opportunities-of-mission-oriented-innovation-policy-in-korea_d725304c-en.html.

issues and directed Korea's public diplomacy initiatives in the region. Her career also encompasses roles in the Ministry's Human Rights Division, Spokesperson's Office, and Protocol Office.

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