# A Strategic Roadmap for Artificial Intelligence and Advanced Biotechnology Established in Efforts to Secure the "Super-gap" Technology that will Shape the Future of Innovation

- MSIT holds the fourth meeting of the Special Committee on the Critical and Emerging Technologies (CETs) under the Presidential Advisory Council on Science and Technology (PACST)

- The Strategic Roadmap to designate nationwide missions and provide investment & policy directions for eight key technologies in future innovation areas (e.g. AI, advanced biotechnology)

- To promote research to secure high-efficiency learning models (that reduces data and power usage by more than 50%), artificial general intelligence (AGI), and synthetic biology technology that can enhance bio-manufacturing efficiency by up to 10 times

<**Summary**>

The Ministry of Science and ICT ("MSIT"; Minister Lee Jong-Ho) deliberated and voted on the Mission-oriented, Strategic Roadmap to foster key technologies that will shape the future of innovation, such as artificial intelligence (AI) and advanced biotechnology, at the meeting of the Special Committee on the Critical and Emerging Technologies (CETs) under the Presidential Advisory Council on Science and Technology (PACST) on Tuesday, October 31, 2023.

With a goal to boost our global competitiveness by integrating and converging different technology areas and secure key technologies, the Korean government selected two future innovation areas. For the two areas, it set nationwide missions to be accomplished by

2030 and also key technology targets for the missions, and its investment directions to support this endeavor.

In the field of artificial intelligence, Korea seeks to develop highly efficient learning models that can reduce data and power consumption by more than 50%, and secure innovative original AGI technologies (commonsense reasoning, multimodal system) and explainable AI.

In the field of advanced biotechnology, the focus will be on addressing challenges through the convergence of digital and biotechnology. The main goals include advancing synthetic biology that would enhance the efficiency of the bio-manufacturing process by up to 10 times, generating big data of Koreans, and securing gene transfer technology to treat incurable diseases.

In line with the implementation of the Special Act on the Promotion of Critical and Emerging Technologies, the Korean government plans to provide all-out support to advance world-class research, with a focus on the Strategic Roadmap's goals.

<**Full press releas**e>

The Ministry of Science and ICT ("MSIT"; Minister Lee Jong-Ho) deliberated and voted on the "Mission-oriented, Strategic Roadmap II for the Critical and Emerging Technologies: Areas of Innovation" at the fourth meeting of the Special Committee on the Critical and Emerging Technologies (CETs) under the Presidential Advisory Council on Science and Technology (PACST) on 10 a.m., Tuesday, October 31, 2023.

The Special Committee on the CETs, composed of both public and private sector representatives, operate directly under the PACST to oversee and coordinate policies to promote the 12 CETs selected to respond to the global technological race, secure technology sovereignty, and promote future growth.
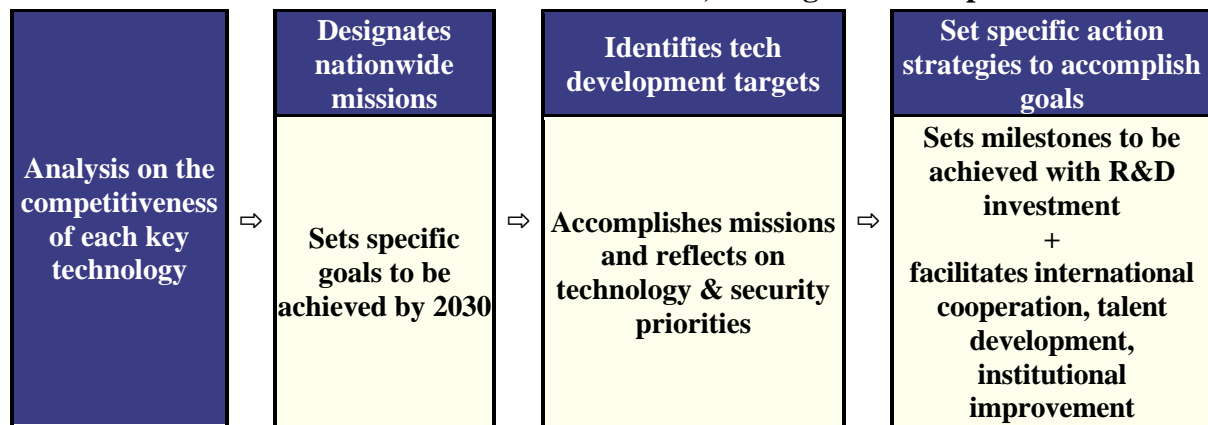
\* The 12 CETs are semiconductor and display, secondary cell, advanced mobility, next generation nuclear energy, advanced biotechnology, aerospace and marine science, hydrogen, cybersecurity, AI, next generation communications, advanced robotics and manufacturing, and quantum technology

## ■ A Strategic Roadmap to Foster Technologies that will Shape the Future of Innovation

The Strategic Roadmap is one of the administration's national tasks, and it sets out a set of goals to be achieved by 2030 under the "strategy for top priority technologies" for each field of strategic technologies. It also identifies enabling technologies to help achieve the goals by taking a top-down approach, and provides key investment directions and measures to foster a favorable ecosystem in a bid to secure the technologies.

\* National task #75: Emerge as a top-five world power in science and technology by securing super gap in the CETs

<Overview on the Mission-oriented, Strategic Roadmap>

| **Analysis on the competitiveness of each key technology** | ⇨ | **Designates nationwide missions**<br><br>**Sets specific goals to be achieved by 2030** | ⇨ | **Identifies tech development targets**<br><br>**Accomplishes missions and reflects on technology & security priorities** | ⇨ | **Set specific action strategies to accomplish goals**<br><br>**Sets milestones to be achieved with R&D investment**<br>**+**<br>**facilitates international cooperation, talent development, institutional improvement** |
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The Korean government established R&D missions and strategies in AI and advanced biotechnology, key critical and emerging technologies, following the roadmaps on semiconductor and display, secondary cell, and advanced mobility in last August, and the implementation of the Special Act on the Promotion of Critical and Emerging Technologies in September.

❶ The roadmap centers on integrating and converging fields of different technology. With recent advancement in big data and hyperscale AI, it is expected that AI and advanced biotechnology will create a ripple effect that resonates far beyond resolving existing technological challenges to addressing social issues and creating new industries. The government conducted an in-depth analysis on synthetic biology and biohealth data utilization, which will be the key technologies that drive the digital transformation (DX) of advanced biotechnology.

❷ The Korean government's goals include securing challenging, next-generation technologies, such as hyper-efficient AI learning models, that could shake up the current landscape of competition revolving around the tech giants and only a handful of countries, and could give rise to a "super-gap" through rapid catching up, despite the relative lack of resources.

❸ The roadmap was designed with strategic consistency in mind, covering R&D investment to overhauling the evaluation process, reflecting the flagship agendas across ministries, such as securing AI trustworthiness, leading the development of global norms, and facilitating full-scale convergence of digital and biotech technologies.


## ■ Artificial Intelligence: Leap to Become an Industrial and Technological Leader Through the Establishment of Critical Technology and Industrial Utilization Base

As the use of hyperscale AI systems such as Chat-GPT and LLaMA is becoming more widespread, the scale of data and resources consumed in AI training processes is significantly increasing, leading to excessive focus on big tech companies that enjoy economies of scale. In response, the Korean government aims to get a head start in next-generation technologies that will change the current landscape of quantitative competition, and to secure critical AI technologies and the foundation for industrial utilization. Against this backdrop, the Korean government specified the details for the missions of the four key technologies which include ▲efficient training and advancement of AI infrastructure, ▲advanced modeling and decision-making, ▲industrial utilization of innovative AI, ▲safety and trustworthy AI.

Under these missions, efforts are being made to develop unrefined data-based, distributed, parallel training and cloud optimization technologies that reduce the power consumption of data-processing and computing used for AI training by more than 50%. In particular, challenges in existing AI, such as training with minimal data, collaboration among AI models, common-sense reasoning, multi-modal* technology, and neuromorphic AI are being addressed to secure the original technology for human-centric artificial general intelligence (AGI) and promote entry into global leading groups.

*Artificial intelligence that accepts various communication methods simultaneously, including text-based question and answer, images, audio, and video.

Specifically, enhancing AI trustworthiness in response to the "technology bloc formation" of major countries led by the European Union's AI Act has been identified as a key mission. To achieve this, efforts are focused on developing automatic detection technology of rights infringement by AI-generated content (with a detection rate of over 90%), ensuring model robustness against biased and contaminated data, and securing explainable AI (XAI) technology that allows AI models to assess and present the conclusion-drawing process, its meaning and inherent vulnerabilities.

Proposed measures for creating an ecosystem to support these efforts include ▲taking global leadership based on the Digital Bill of Rights and the AI Act (which is under legislation process) and ensureing trustworthiness in high-risk areas\*, ▲providing convergence training for non-experts and strengthening digital literacy for digitally marginalized groups to bring AI into daily lives, among other initiatives.

\*(High-risk areas related to AI) Technologies with high potential for misuse, such as biometric information recognition, deepfakes, and areas directly impacting citizens' lives such as energy, transportation, employment, loans evaluations, public use, and nuclear power.

■ **Advanced Biotechnology: Proactive Response to Digital-Bio Convergence and Leaping to Become a Bio-Manufacturing Powerhou**se

As the convergence of digital technology and biotechnolgy extends the paradigm of life science into advanced value chain and customized research for solutions to challenges, new opportunities for our industry to chase leading industries are expected to emerge. With the goal of "proactive response to digital-bio convergence and leaping to become a bio-manufacturing powerhouse," a roadmap centered on four key technologies has been established: ▲synthetic biology, ▲gene and cell therapy, ▲infectious disease vaccines and treatments, and ▲digital health data analysis and utilization.

Synthetic biology, which has high security value and far-reaching effects on related industries like materials and energy, is an industry with high demand for technological self-sufficiency. As such, the industry is striving to secure innovative technologies that leverage AI

and robotics to automate, speed up, and reduce costs by up to 10 times in the design and production efficiency of bio components such as genomes and proteins. Also, the roadmap identifies other important tasks of developing processes such as rapid screening of bio components (proteins, genomes), cultivation, and purification. At the same time, the roadmap lays out key equipment and software to procure, as well as the need for the implementation of a digital twin in the bio-manufacturing process.

In addition, the roadmap focuses on developing next-generation cell therapies with secured safety, including core technologies such as genetic material delivery (RNA platform, virus vectors), with the aim of entering clinical trials for novel treatments for intractable diseases by 2030. Response to infectious diseases will also be enhanced, particularly by advancing vaccine platforms, with a focus on mRNA technology that has high ripple effects in other fields. Furthermore, Korea aims to lead the digital transformation of biotechnology by establishing a bio big data repository of Koreans (with a target of collecting data of over one million individuals). Establishing a cloud-based analysis infrastructure and applying generative AI for solving challenges in analyzing new drug candidates and disease diagnosis are among other goals.

Plans to build the foundation for supporting innovative research and development include ▲training professionals specializing in bio-AI convergence and manufacturing, ▲strengthening joint research and networking with major global research institutions and pharmaceutical companies, ▲promoting standardization and sharing of bio-medical data, and ▲strengthening regulatory science and open innovation capabilities for swift market entry of excellent research outcomes.

The tasks and goals outlined in the established roadmap will be utilized as key criteria for government research and development investments and evaluations. Particularly, considering the rapid pace of technological advancement in artificial intelligence and advanced biotechnology, the goals set for 2030 will be continuously reviewed and adjusted in line with changes in technological and industrial trends.

Joo Young-chang, Vice Minister for the Science and Technology Innovation Office, Ministry of Science and ICT (Also Chairman of the Special Committee on CETs) stated, "Artificial intelligence and advanced biotechnology, for which the roadmap was established today, are technologies that will lead not only the competition for technological supremacy, but also the growth of our future generations and innovation in all industries. Driving mission-centered R&D projects and securing cutting-edge technologies are crucial above all else." He further mentioned, "In line with the enactment of the Special Act on Nurturing Critical and Emerging Technologies, the Science and Technology Innovation Office will concentrate its support on world-class research based on the key goals outlined in the roadmap."

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