[Tentative Translation]

Science, Technology, and Innovation Basic Plan

March 26, 2021

Government of Japan

TABLE OF CONTENTS

Introduction

We are at a crossroads of a great age. Science, technology, and innovation policies will continue to be formulated in every country for the foreseeable future in two major directions. In other words, science and technology require wisdom to overcome global crises stemming from the explosive expansion of human activities since the late 20th century. At the same time, each country will accelerate domestic reforms and expansion of future investment in science and technology to strengthen its competitiveness, while competing with other countries in various international proposals and concepts for global cooperation and harmony.

These heritages of the 20th century, also called the Great Acceleration[1] such as the exponential growth of the population, the growing urban environment, the myth of GDP[2] growth supported by mass production and mass consumption, and the progress of globalization that seeks to surpass national constraints, are increasing atmospheric CO_2 and methane gas, as well as creating marine pollution caused by the outflow of plastics and global crises such as extreme weather, climate change, and impacts on marine ecosystems. This is also a recognition of the global challenge posed by the hypothesis that the Anthropocene epoch has emerged[3]. Meanwhile, the world is increasingly in turmoil, with the United States and China increasingly confronting each other, and the security environment in our country is becoming increasingly severe. Japan's science, technology, and innovation policy, which is set forth in the Sixth Science, Technology, and Innovation Basic Plan (Hereinafter referred to as the "Sixth Basic Plan".), must intend to make a political contribution to resolving these global issues. On the other hand, it is essential for the government to take a domestic perspective on what benefits science, technology and innovation policy will bring to each and every citizen. Our country has already faced challenges such as a declining birthrate, an aging population, and depopulation. In recent years, however, the country has been facing new social challenges, such as worsening natural disasters and declining international competitiveness in science and technology. Issues related to the next generation of human resources, such as the lack of self-affirmation among the younger generation, have also been highlighted. In order to solve these problems, the creation of diverse knowledge, not only in the natural sciences but also in the humanities and social sciences, as well as the redesign of existing society as a whole through the convergence of knowledge and the development of human resources to carry out these tasks are unavoidable.

What policy can be adopted to harmonize the two axes of contribution to global issues and domestic structural reform? What is required in the Sixth Basic Plan is the creation of policies for this purpose.

At that time, what we should aim for is to make Society 5.0, "a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace[4] and physical space" set forth in the Fifth Science and Technology Basic Plan (Hereinafter referred to as the "Fifth Basic Plan".), a reality. While strongly sympathetic to the proposal of the Sustainable Development Goals (SDGs[5]) adopted at the United Nations Summit in 2015, we will combine them with the unique values of trust and sharing that Japan emphasizes and re-introduce Society 5.0 as a vision of Japan's future society beyond the negative legacy of the 20th century. We will ask the world about Society 5.0 as a vision of our country's future society by linking the values of soft power such as the realization of a recycling-oriented society in harmony with society and nature, a sense of citizenship based on trust, common belief of “good for everyone”, and empathy for sharing, with highly reliable scientific research and technological capabilities, as well as the existence of extremely high-quality social data. In addition, by proposing this concept, Japan aims to strengthen cooperation with countries, regions, and international organizations that can share this sense of value, and to become a cornerstone of trust in the international community.

Based on this basic understanding, the Sixth Basic Plan expressed the vision for the future society of Society 5.0 that Japan should aim for as "a society that is sustainable and resilient, that secures the safety

---

1 Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O. & Ludwig, C. The trajectory of the Anthropocene: The Great Acceleration. The Anthropocene Review 2: 81 -98, doi: 10.1177/2053019614564785 (2015)

2 Gross domestic product

3 In 2000, atmospheric chemist Paul Crutzen, who won the Nobel Prize in Chemistry, proposed that the Earth has moved from the Holocene epoch, which has lasted from 17,000 years ago until the present, to the Anthropocene epoch due to human impact on the global environment. As of February 2021, the Anthropocene epoch has not received official approval by any international academic society.

4 New social areas where diverse service supply chains and communities are formed

5 SDGs: Sustainable Development Goals

and security of the people, and that enables each and every one of them to realize diverse happiness (well-being)" and set forth the direction of science, technology, and innovation policies that ”a virtuous cycle of ‘social transformation through the convergencge of knowledge’ and ‘investment in knowledge and people’” toward the realization of this vision. In order to achieve this goal, the government will secure approximately 30 trillion yen in investment in research and development over the next 5 years, and the public and private sectors will jointly invest approximately 120 trillion yen in research and development using this investment as a catalyst. Over the next five years, in line with this direction, we will boldly promote each policy and redesign society as a whole. At the same time, we will pioneer the frontier of knowledge and develop human resources to take on challenges in response to the demands of society, and we will create a dynamic virtuous cycle that will further accelerate social reform. With the power of science, technology, and innovation, we must realize an all-inclusive society in a new world order, together with countries that respect regional, gender, language and cultural diversity and share the principles of freedom and trust. Japan should play a central role in this.

Looking back, science and technology served as the basis for Japan's recovery from the devastation of the postwar period. If that is the case, then in an era facing a global crisis, also called the Anthropocene epoch, we will put Society 5.0 to the forefront as a universal and global image of our future society in order to achieve what the Constitution of Japan declares, "we desire to occupy an honored place in an international society." This is the central message of the Sixth Basic Plan.

Chapter 1 Basic Philosophy

1. Recognition of the current situation

When the Fifth Basic Plan was formulated, the following were recognized as major issues : response to changes in the global industrial structure due to the rapid evolution of information and communications technology (ICT[6]) and networking such as security issues; global constraints on energy, resources, and food; environmental issues; and risks such as the declining birthrate and aging population, exhaustion of local economies and societies, and risk of natural disasters.

While all of these issues remain important today, notable new social changes that have emerged over the past five years include the reorganization of the world order, the global agenda that has become a real threat, and the exposure of the limits of the information society (Society 4.0). The spread of Coronavirus Disease 2019[7] has accelerated these changes.

(1) Changes in the situation at home and abroad

1) Beginning of a world order reorganization

The current world is becoming increasingly chaotic due to changes such as the rise of China and the radicalization of the intense confrontation between the United States and China. The search for a new world order brought about by such geopolitical changes is an emerging competition among countries and a new trend toward cooperation in which international cooperation is being restructured for the survival of the country.

Science, technology, and innovation are at the core of an increasingly intense struggle for supremacy between countries. Major countries such as the United States and China are devoting themselves to cutting-edge basic research and the practical application of the results, positioning the fruits of such research as effective measures for responding to security threats, etc. and promoting efforts to utilize them, including in response to global epidemics of infectious diseases, international terrorism and cyber-attacks, and increasingly severe large-scale natural disasters. In these circumstances, the problem of technology leakage has also emerged, and each country is strengthening efforts to prevent this.

Looking at the situation in each country, while expectations for the role of the government is rising, and while each country supports the employment, business, and livelihood of the people through large-scale fiscal measures, there are divisions at the regional and community levels. From a global perspective, while the importance of mobilizing wisdom, cooperation, and solidarity in the international community beyond the framework of a single country is strongly recognized, the ideal form of leadership in the world is being questioned.

In this way, countries around the world are in an age of groping for ways to establish a national and global order, and Japan, too, is required to play a leading role in creating a new world order and rules.

2) Global agenda as a real threat

Various issues facing the world (the global agenda), such as climate change, biodiversity degradation, and the risk of a pandemic caused by an increase in the number of people interacting with each other, have become real threats, warning our society, and global corporate activities have begun to focus not only on efficiency, but on sustainability and resilience as well.

In particular, the climate change problem caused by global warming has manifested in the form of large-scale natural disasters with high frequency and severity, posing a real threat. It has become the most serious problem facing mankind, which is also called a climate crisis. In light of this, foreign countries such as European countries, the United States, and China are planning large-scale investment[8] in order to carry out economic recovery and environmental investment, both of which

---

[6] ICT: information and communications technology

[7] Coronavirus Disease 2019: COVID-19

[8] The European Commission announced that about 30% of the total budget of about 1.8 trillion euros

have been depressed by the coronavirus, in an integrated manner.

At the 203rd session of the Diet in October 2020, the Prime Minister declared that Japan would aim to reduce greenhouse gas emissions to net-zero by 2050, in other words, to create a carbon-neutral society. The growth strategy would be based on a virtuous cycle of the economy and the environment, and Japan would make every effort to realize a green society through policies such as those promoting revolutionary innovations and regulatory reforms to realize a decarbonized society.

3) Exposure of the limits of the information society (Society 4.0)

As the world shifts from an industrial society (Society 3.0) to an information society (Society 4.0), IT[9] platformers such as GAFA[10] have built business models and services that are free from traditional business practices and rules, and have led international economic activities that generate huge profits.

At the same time, problems have emerged that can be called harmful to individual happiness. These include strong concern about the fact that international information monopolies by IT platformers are constraining free competition, the emergence of information-vulnerable people who are left behind in the information age, and the uneven distribution of wealth in which a small number of wealthy people own the world's wealth, resulting in disparities, social divisions, and anxiety about the future.

The scope of the Sixth Basic Plan is to define Japan's position in response to these domestic and international changes.

(2) Expansion of the novel coronavirus that accelerated the changes in the situation

1) Major changes in the international community

Since around December 2019, Coronavirus Disease 2019 caused by the novel coronavirus[11] has spread from China to the world. In March 2020, the World Health Organization (WHO) [12]declared that the spread of the novel coronavirus could be characterized as a pandemic, and this has become one of the major factors to be considered for mankind.

While the sharing of infectious disease countermeasures and the development of vaccines and therapeutic drugs should be promoted through international cooperation as common policy objectives for the survival of mankind, each country is under pressure to make rapid changes in order to secure the safety and security of their citizens such as preventing the spread of the infectious disease and maintaining economic activities, for the continued existence and prestige of the nation. In addition, the fragility and danger of the international supply chain, which was built with a focus on efficiency, was exposed in the face of the spread of the novel coronavirus, which is pressing each country to review the sustainability and resilience of its economy. Such movements are accelerating the reorganization of the world order, which has become tangible.

2) Rapidly changing people's lives

Domestically, the novel coronavirus has completely changed our lives and has brought about extraordinary things by force. In particular, it has become clear that digitalization of society as a whole, which is a prerequisite for the realization of Society 5.0, has not progressed sufficiently. The progress

---

(219 trillion yen) for the reconstruction fund and the multi-year fiscal framework from 2021 to 2027 will be spent on climate change measures. The new Biden administration of the United States plans to raise 400 billion dollars (38 trillion yen) over four years to return to the Paris Agreement and promote the introduction of clean energy infrastructure and technologies. China plans to invest about 10 trillion yuan (150 trillion yen) in clean energy and next generation infrastructure by 2025 as a new basic infrastructure construction policy.

[9] IT: Information Technology

[10] GAFA: Google, Amazon, Facebook, Apple

[11] Novel Coronavirus: SARS-CoV-2

[12] WHO : World Health Organization

of environment improvement in response to digitalization, such as the digitalization of administration, telework in enterprises, and online education in universities, has varied depending on the organization or institution, and society as a whole is still in the process of introduction.

This pandemic has served as an opportunity to change the way our society should be. In Japan, too, efforts have already begun in areas such as work styles and learning styles, medical services, food and drink, and tourism in a way that is significantly different from the conventional common sense. Efforts such as telework, online education, and remote medical care, which have been discussed many times up to now, are rapidly advancing as a result of being forced to respond to the novel coronavirus.

Specifically, in July 2020, the Declaration to be the World's Most Advanced IT Nation: Basic Plan for the Advancement of Public and Private Sector Data Utilization[13]was compiled, and a policy was formulated to promote both the use of IT to prevent the spread of the novel coronavirus and the transformation of social structure and social behavior through digital resilience. In October 2020, the Digital Government Ministers' Meeting was reorganized to strengthen the system chaired by the Prime Minister in order to materialize and accelerate these efforts. Under the Ministers' Meeting, measures to fundamentally improve the digital infrastructure of the national and local governments, including the My Number system, and data strategies for public and private sector data utilization were compiled.

In order to further promote online administrative procedures, the Cabinet Office Council for Promotion of Regulatory Reform and the Cabinet Secretariat Headquarters for the Promotion of Administrative Reform took the initiative in formulating policies for reviewing documents, seals, face-to-face meetings, etc. with regard to civil-to-government application procedures, etc. and with regard to internal administrative accounting and personnel procedures, etc., respectively.

Furthermore, the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society will be comprehensively reviewed, and in February 2021, a cabinet decision was made on digital reform-related bills[14] and submitted to the Diet as a breakthrough for breaking down the vertical division of administration and boldly carrying out regulatory reform. As a result, the new lifestyle, also known as the "new normal," partly embodies the concept of Society 5.0, which was laid out in the Fifth Basic Plan.

---

[13] Cabinet decision of July 17, 2020

[14] A cabinet decision was made on February 9, 2021 on the bill for the Basic Act on the Formation of a Digital Society, bill on the Act to Establish a Digital Agency, bill on the Act Related to the Formation of a Digital Society, bill on the Act Related to the Registration, Etc. of Deposit and Savings Accounts for the Swift and Reliable Payment of Public Benefits, bill on the Act Related to the Management, Etc. of Deposit and Savings Accounts Through the Use of Individual Numbers Based on the Will of Depositors and Saving Holders, and bill on the Act Related to the Standardization of Local Government Information Systems. They were submitted to the 204th session of the Diet.

2. Sixth Basic Plan as Science, Technology, and Innovation Policy

In Japan, the Basic Act on Science and Technology, which serves as the basis for the Science and Technology Basic Plan, was revised in June 2020 to change its name to the Basic Act on Science, Technology, and Innovation in April 2021, and the promotion of the humanities and social sciences and the creation of innovation will be added to the scope of promotion of the Act. This means that the Science, Technology, and Innovation Policy has become a policy that contributes to the comprehensive understanding of human beings and society and to the solution of problems, not only through the promotion of science and technology, but also through the convergence of knowledge that is the fusion of knowledge in the humanities and social sciences and knowledge in the natural sciences that creates social value.

(1) Review of science and technology policies based on Japan's Science and Technology Basic Plan

1) History of the first to fourth periods

The First Science and Technology Basic Plan was formulated in 1996 based on the Basic Act on Science and Technology. At that time, Japan, as one of the world's frontrunners, was required to change its policy from a science and technology policy that followed Europe and the United States to one that would challenge unexploited science and technology fields and open up the future, and to contribute to the issues facing humanity. Against this backdrop, Japan placed emphasis on expanding government investment in R&D, reforming the R&D system, and strategically prioritizing R&D.

The Second and Third Basic Plans set the main goal of enhancing Japan's international competitiveness by making priority investments in important research areas while science and technology activities were becoming larger and more complex. The Fourth Plan, which focused on social implementation of science and technology, shifted its focus to social reform and problem-solving by returning the results of research and development to society through the power of innovation.

2) Concept of Society 5.0 proposed in the Fifth Basic Plan

At the time of formulating the Fifth Basic Plan, ICT had advanced around the world, and global IT platformers had significantly changed their business models. In addition, European countries, the United States, and China were trying to bring about structural changes in industries, which could be called the fourth industrial revolution, by making the most of ICT in the manufacturing field.

Under such circumstances, Japan come up with a new concept for building a future society that will solve the problems facing Japan and the world and bring true prosperity to people by putting human-centered values on a new method of merging cyber space and physical space, in order to make the most of ICT and make it a driving force for the realization of not only an industrial structure but also a rich and high-quality life for the people. This is the "Society 5.0" proposed in the Fifth Basic Plan formulated in 2016.

This concept was consistent with the vision of the future guided by digital transformation[15] (hereinafter referred to as "DX"), in which the penetration of ICT changes people's lives in a better direction in all aspects.

3) Digitalization for its own sake and relative decline in research capabilities (review during the 5th Basic Plan)

Looking back at the Science, Technology, and Innovation Policy during the Fifth Basic Plan, digitalization, which is the premise of Society 5.0, was promoted in all fields. However, efforts aimed at improving the efficiency of existing operations were at the core, and creation of new business models through data collaboration and utilization, as in other countries, could not be done sufficiently, and the original power of ICT could not be fully utilized. In particular, as revealed by the coronavirus pandemic, IT infrastructure for online meetings and telework has problems such as operational

[15]A concept proposed by Professor Eric Stolterman of Umeå University (Sweden) in 2004.

problems and psychological concerns regarding its stability and security. In addition, under the current situation in which each organization uses networks in different systems in a closed manner, there is no environment for real-time data collection, analysis, and utilization across sectors. Thus, there was a lack of sense of speed and sense of crisis in infrastructure development for realizing Society 5.0.

For this reason, during the period of the Fifth Basic Plan, the government is promoting the development of public and private data utilization environments through the development of data collaboration infrastructure and the formulation of AI Strategy 2019[16], as well as the creation of innovation through the establishment of large-scale programs for solving social issues such as SIP[17] and the Moonshot Research and Development Program.

With regard to research capabilities, although a large number of Nobel Prize winners have been produced, the international position of research papers in terms of both quantity and quality has continued to decline, and the environment surrounding young researchers who support research capabilities continues to be severe, with an increase in the number of posts with fixed terms and a decrease in the time available for research.

During the period of the Fifth Basic Plan, efforts were made to improve the research environment. However, under the constraints of the existing framework, measures to truly drive innovation in the research field were not always implemented with sufficient speed and scale. For this reason, drastic measures have been taken, such as the formulation of a comprehensive package to strengthen research capacity and support young researchers[18] in January 2020, but progress is still midway.

(2) Full-scale revision of the Science and Technology Basic Law for the first time in 25 years

At the 201st session of the Diet in 2020, the Basic Act on Science and Technology was revised in earnest for the first time in 25 years. In this revision, the name of the law was changed to Basic Act on Science, Technology and Innovation, and the part related to "other than science or technology whose sole concern is the humanities and social sciences (the law states "the humanities")," which had been excluded from the provisions of science and technology, was positioned within the scope of "science and technology," which is the subject of the law, and "creation of innovation"[19] was set as one of the pillars.

The promotion of the humanities and social sciences as one of the pillars of the revised Basic Act on Science and Technology, was added to the scope of the law because the policy for science, technology, and innovation had changed from targeting only R&D to a policy that creates social value. In the future, it will be necessary to question the value of each individual and the value of the global scale in the policy. In the future, it will become increasingly important to accumulate “knowledge” with depth in the humanities and social sciences, and to create and utilize “convergence of knowledge” that contributes to comprehensive understanding and problem solving of human beings and society through fusion with “knowledge” in the natural sciences. It is also necessary evolve the science, technology, and innovation policy itself into a policy that provides solutions to society by taking in the value-finding viewpoint that is the true value of the humanities and social sciences.

Another pillar, the creation of innovation, has been added to the scope of the law due to the

---

[16] Decided by the Council for Integrated Innovation Strategy on June 11, 2019. A follow-up on the strategy was held in June 2020.

[17] SIP: Cross-ministerial Strategic Innovation Promotion Program

[18] Decided by the Council for Science, Technology and Innovation on January 23, 2020. Developing Research Capacity Improvement Reform 2019, it is a policy packaged formulated to comprehensively and fundamentally strengthen Japan’s research capacity through an integrated reform of human resources, funding, and environment.

[19] The Basic Act on Science, Technology and Innovation defines the “creation of innovation” as “to generate new value through scientific discovery or invention, development of new products or services, or other creative activities, and through the dissemination thereof, create great change in the economic society.”

significant change in the implications of the concept of innovation over the past 25 years. The concept of innovation, which was once seen as an act directly connected to product development and production activities in corporate activities, is now seen as an activity by a wide range of actors that creates major changes in the economy and society, and is evolving into the concept of transformative innovation which focuses on the creation of new value and the transformation of society itself.[20]

The two pillars of this revision are essential for Japan's efforts to realize Society 5.0 by drawing up a vision of the future through "convergence of knowledge", formulating policies through backcasting, and promoting social change through the creation of innovation. The 6th Basic Plan aims for more advanced science, technology, and innovation policies from the perspective of "convergence of knowledge."

On the other hand, basic and academic research is becoming increasingly important not only for discovering and identifying new phenomena, but also for creating "knowledge" that will lead to the creation of original new technologies. "Knowledge" is the source of innovation creation that will respond to discontinuous changes and solve social problems. We have a duty to hand over to the next generation the vast amount of "knowledge" accumulated over the long history of mankind, and at the same time, to open up frontiers and create new "knowledge" by discovering and identifying new phenomena and presenting new concepts and values.

Japan must make efforts to further strengthen its basic research capabilities, such as strengthening outstanding research that leads the world and securing various research sites that serve as a basis for rich ideas.

It is also important to strengthen international cooperation to link research activities to the global agenda, and to build a mechanism to utilize created knowledge for innovation.

In particular, in recent years, there have been cases in which basic research and academic research have been directly linked to social implementation, such as deep learning in AI technology and genome editing technology. There is a need for a mechanism for close cooperation between industry and academia, such as start-ups established by universities and national research and development institutions and the advancement of industry-academia cooperation.

(3) Direction of the Sixth Basic Plan

Based on the changes in the domestic and international situation over the past five years, the Sixth Basic Plan must demonstrate to the world through policy creation how to bring about diverse well-being for each and every citizen of the world by realizing the two axes: contribution to overcoming global issues such as the exploration of a world order such as the intensifying confrontation between the United States and China and the climate change issue, which has become a real crisis; and domestic structural reform in response to the coronavirus pandemic, which has brought about extraordinary things by being semi-forced.

In order to achieve this, it is necessary to materialize Society 5.0 set forth in the Fifth Basic Plan with a strong awareness that we must push through social reforms, based on the experience that the transition from an industrial society (Society 3.0) to an information society (Society 4.0) was not an extension of the past due to changes in the social structure, including lifestyle and industrial structure. At the same time, it is necessary to demonstrate to the world Society 5.0 as the image of Japan's future society beyond the negative legacy of the 20th century, by combining Japan's unique values that emphasize trust and sharing with the SDGs, and by Japan's highly reliable scientific research and technological capabilities with the presence of extremely high-quality social data.

By embodying this vision of a future society, Japan aims to strengthen cooperation with countries, regions, and international organizations (such as the EU, the G7, and the OECD) that can share these values and enhance Japan's presence in the international community.

---

[20]Innovation aimed at social change in order to respond to complex and wide-ranging social issues such as global environmental issues.

3. Realization of a future society called Society 5.0

(1) Society for which Japan aims (Society 5.0)

Society 5.0 is proposed in the Fifth Basic Plan, etc. as "a human-centered society in which economic development and the resolution of social issues are compatible with each other through a highly integrated system of cyber space and physical space"[21]. It is necessary for the Sixth Basic Plan to embody this in light of domestic and international changes.

Although economic development remains one of the objectives that should continue to be pursued, the meaning of the GDP indicator is changing as economic activities in cyberspace with no borders are rapidly expanding, and people's values are also changing as they emphasize diverse happiness and contribution to the nation and the world not limited to pursuing wealth. In light of these changes, it can be said that ensuring the safety and security of the people, which is the major premise of economic development, building a sustainable and resilient society, and creating a world where everyone can pursue diverse happiness, will lead to economic development.

In particular, overcoming immediate threats, such as pandemics and major weather disasters posed by climate change, and gaining insight into and preparing for the discontinuous changes that will occur in the future, are urgent issues for Japan. With ICT penetration, the promotion of DX as a new value that will change people's lives for the better in all aspects, opens up the possibility of providing solutions that meet individual needs. These achievements will lead to changes in the business models of companies and reform of the industrial structure, which in turn will contribute to Japan's international competitiveness.

Based on this background, the expression of the society for which Japan aims can be summarized as "a society that is sustainable and resilient against threats and unpredictable and uncertain situations, that ensures the safety and security of the people, and that individual to realize diverse well-being." The realization of such a future society is the purpose of formulating the Sixth Basic Plan. This is also in line with the SDGs.

1) Sustainable and resilient society that ensures the safety and security of the people

Japan's society and people's lives are exposed to various threats such as disasters, unknown infectious diseases, and cyber terrorism, and the security environment surrounding Japan is becoming increasingly severe, which is one of the causes of great anxiety among the people. In addition to these threats, the establishment of stable and robust economic activities is also required, as exemplified by the intensification of technological hegemony disputes between the United States and China, and the risks of disruption of the international supply chain and technology outflow emerging. Therefore, the maintenance and securing of Japan's technological superiority is the key.

With regard to environmental issues, the increase in human activities places a large burden on the global environment, causing global environmental crises in various forms such as climate change, marine plastic waste, and biodiversity loss. In order to realize a society in which future generations can live in abundance while satisfying the needs of the present generation, it is essential to reform the conventional economic and social systems and daily life of mass production, mass consumption, and mass disposal such as addressing the food waste problem, while harmonizing them with the environment, economy, and society in order to resolve issues in Japan’s social security system, etc. in a manner that addresses the declining birthrate and aging population and changes in the economy and society.

The government is required to strengthen Japan's international competitiveness by leveraging the development of science and technology, and to aim at building a sustainable and resilient society that can always respond appropriately to these various threats and realizing comprehensive security. It is necessary to enhance and strengthen various efforts to ensure the safety and security of the people. When doing so, considering that science and technology have diversity and the results of R&D

---

[21]The Fifth Basic Plan states, " Through an initiative merging the physical space (real world) and cyberspace by leveraging ICT to its fullest… a “super smart society” that will bring wealth to the people. "

conducted for a certain purpose can be applied to other purposes, it is essential that the results are utilized appropriately.

2) A society in which each individual can realize diverse well-being

Our society, which regards the expansion of economic wealth as the manifestation of affluence and has aimed to increase GDP as a representative indicator, is facing the negative effects of economic priorities, such as environmental destruction, the uneven distribution of world wealth, and social division.

In the world of Society 5.0, what should be achieved is not only the expansion of economic affluence but also the realization of qualitative affluence including mental health. In order to achieve this, it is necessary to provide education that enables everyone to develop their own abilities individually, to have many opportunities to work using their abilities, to have multiple jobs at the same time in order to choose a way of life that is more suitable for them, and to have an environment where even if they fail, it is acceptable to society and it is easy to change careers midway. Moreover, such a way of working must not only provide a livelihood, it must also secure sufficient time to spend with family and to enjoy hobbies and leisure.

In addition, in order for many people to live a long, healthy and fulfilling life ~~in an age of 100 years~~, it is necessary to extend not only the healthy life expectancy but also the so-called "social participation life expectancy[22] " in which people can be independently involved with society no matter how old they are.

In addition, there is a need for an environment in which people can always take a positive view of their presence in the community, so that they can continue to have their own dreams and participate in society with a sense of purpose, even if they leave one organization. Being able to improve their own abilities and to be able to find places where they can play an active role without interruption through such an environment is also essential. We will aim to build a society with such inclusiveness.

(2) What is necessary to realize Society 5.0

1) Transforming into a sustainable and resilient society through the fusion of cyberspace and physical space

The transition from Society 4.0 (an information society) to Society 5.0 is impossible with policies that are an extension of existing policies. In order to make this transition, it is essential to redesign the entire society by taking a back-cast approach based on a new vision of the future society.

The key to achieving this is the fusion of cyberspace and physical space, which is the premise of Society 5.0, and the values of a human-centered society. In Society 5.0, every element of society will be built as a digital twin[23] in cyberspace, restructured in terms of systems, business design, urban and regional development, etc., and then reflected in physical space to transform society. In this process, a series of infrastructure (social infrastructure) is required to collect and accumulate high-quality data in a form that enables advanced analysis, and to perform advanced analysis in cyber space using mathematical models and data analysis technology.

By incorporating the human-centered values into these new processes, we will encourage individual Japanese citizens and citizens of the world to play a central role in decision-making, and society will change flexibly and expeditiously into a better shape. We will provide highly convenient services that are tailored to individual citizens, solve various social issues, and build a sustainable and resilient society. Furthermore, we will open the way for new industries and new cities to bloom, and it will be possible to present a new model for the international community to overcome global challenges represented by climate change.

---

[22]Average period of active engagement with society.

[23]A cyberspace reproduction of a real world consisting of elements such as geography, humans, organizations and time in which a large amount of high-quality and reliable data are linked with each other.

2) Creation of knowledge as a source of value creation by designing a new society

In order to design a new society and promote the creation of new value in that society, a variety of knowledge is necessary. In particular, in order to respond to ELSI[24] that arise when new technologies are used in society at the time of the transition to Society 5.0, it is necessary to look at things from an overhead perspective. It is necessary to construct a system that can utilize convergence of knowledge not only in natural science but also in humanities and social science.

Knowledge is a source of innovation that responds to discontinuous changes and solves social problems. It is necessary to open up frontiers by discovering and identifying new phenomena and presenting new concepts and values based on the intrinsic motivation of researchers. There is accumulation of various types of research such as basic research and academic research, and as a result of this accumulation, at times creative results are created and new technologies and new knowledge that change the world are born.

3) Developing human resources to support a new society

In the era of Society 5.0, it will be important to develop the abilities and qualities that can be acquired through exploratory activities to discover problems and find solutions by oneself. It will be necessary to produce human resources who can create new value in the world and to realize an education and human resource development system that will realize this.

As the social structure rapidly changes, there is a need for the ability to tackle issues that cannot be addressed by existing frameworks or extensions. From the primary and secondary education stage, it is necessary to realize learning based on curiosity and to strengthen students' inquiring ability to tackle issues.

In addition, the age of 100 years of life has come, and in order to pursue a variety of forms of happiness that suit the interests and interests of each person for an unprecedented length of life, an environment in which there are opportunities for diverse relearning even after becoming a member of society and in which people can pursue a lifestyle that suits the new age is necessary.

At the same time, it is also necessary for society to promote the circulation of knowledge and connect it to the creation of new value. It is also necessary to establish an environment in which individuals can demonstrate their abilities to the maximum at any stage of their lives, build double-track career paths, and take on new challenges.

In addition, when all kinds of information are delivered online and communication is conducted in a non-face-to-face and anonymous manner, such as through social media, there is a possibility that there will be a bias in the information to be touched and the relationship between people based on the assumption of conventional face-to-face communication will change. Information literacy that appropriately responds to such changes in society is required.

Moreover, as the experience of directly touching the real thing decreases, it becomes even more important to accumulate the experience of directly touching the real thing through STEAM[25] education including A and to polish sensitivity and senses.

(3) Dissemination, sharing, and coordination of Society 5.0

In order for Japan to lead the international community during the period of searching for a world order in the post-coronavirus era, it is necessary to verbalize a new social model, values, and strategies for realizing them, to question them in and outside Japan in concrete terms as Society 5.0.

For Japanese citizens, we will continue with efforts such as information transmission in order to improve consistent interest in science, technology, and innovation, such as by encouraging dialogue and collaboration between diverse sectors through the use of various media and spaces for co-creation,

---

[24] ELSI: Ethical, Legal, and Social Implications/Issues.

[25] Cross-disciplinary education to utilize learning in each subject such as Science, Technology, Engineering, Art(s), Mathematics, etc. for finding and solving problems in the real world. In addition, there are cases in which the scope of A is narrowly defined as design or sensitivity, and cases in which it is defined in a wider range including art, culture, life, economy, law, politics, ethics, etc.

etc., and vitalize the resolution of social problems through civic participation and citizen science. We will also share and cooperate on this social image with respective countries, regions, international organizations, etc. (EU, G7, OECD, etc.).

In other words, we should present our vision to the world as a future image that incorporates elements such as traditional values, modes of behavior of compassion and empathy for others, and co-creation based on trust, which are historically and culturally inherent in the Japanese people[26], while working to rebuild society as a whole based on the major trends of the times, namely digitalization, data collaboration, and utilization. Using this new social model, we will draw a future image that will lead to the assurance of safety and security and the maximization of diverse well-being of each individual, in cooperation with countries that share our values.

Japan, the third largest economy in the world in terms of GDP, aims to create a new future society for the first time in the world at this turning point, which can be said to be a paradigm shift. By doing so, Japan aims to attract the attention of the world, attract the interest of world-class human resources and investment in the future, and establish itself as a place of co-creation. Once established, Japan will occupy an honored place in the international community.

In 2025, the Expo 2025 Osaka, Kansai, Japan will be held. The Expo, which is based on the theme of "Designing Future Society for Our Lives," will be a befitting showcase for Society 5.0. We need to present a concrete image of the future society without wasting this chance.

[26]For example, Japan has a certain kind of ethical and social view of symbiosis with nature; value of sharing; and good for the seller, good for the buyer, and good for society that it has cultivated over many years.

Chapter 2 Science, Technology, and Innovation Policy for the Realization of Society 5.0

Chapter 1 presented a sustainable and resilient society that ensures the safety and security of the people and a society in which each and every person can realize a variety of well-being as the future society for which Japan aims (Society 5.0). It also took up the following items that are necessary for realizing Society 5.0: redesign of society, construction of social infrastructure in cyberspace, creation of knowledge, and development of human resources.

In this chapter, these points are divided into three sections based on the concept of the revised Basic Act on Science and Technology: the image of society as a result of the creation of innovation (social change), research capabilities to develop frontiers of knowledge, and human resource development to support the creation of science, technology, and innovation. With a view to 2030, the measures to be taken by the government over the next five years are summarized.

With regard to specific initiatives, we will clarify who will do what by when[27], and aim to achieve targets together with stakeholders by sharing predictability with stakeholders and aim to achieve targets together with stakeholders and with relevant control tower councils and relevant ministries through cross-sectoral coordination by the Science, Technology, and Innovation Promotion Secretariat[28] under the control tower functions of the CSTI.[29]

Based on Chapter 1, the major objectives of the three sections are as follows:

- Enable each and every one of the people to enjoy diverse happiness by redesigning Japan's society, achieving solutions to global issues ahead of the rest of the world, and ensuring the safety and security of the people.
- Continue to create knowledge with diversity and excellence, and restore the world's highest level of research capabilities
- In order to transform Japan as a whole into Society 5.0, develop human resources who pursue diverse happiness and face challenges.

In implementing these science, technology, and innovation policies, it is necessary to always be strongly aware of the perspective of international cooperation and competition. For example, since innovation is created through collaboration and competition among diverse human resources, strengthening the international brain cycle is an essential requirement for vigorous research and development. Japan must promote exchanges of knowledge globally and strengthen its research and innovation capabilities. On the other hand, there are emerging concerns about competition for supremacy among countries over technology and international technology leakage. Under these circumstances, research organizations such as universities and their researchers are required to conduct risk-aware research management. In particular, the government is required to show a certain direction so that researchers can understand the significance of research soundness and fairness (research integrity) and fulfill their responsibilities to society, as well as participate proactively in international science, technology, and innovation activities.

Based on this, Japan will develop new science and technology diplomacy, taking into account its contribution to the resolution of global issues, the strengthening of international communication, and the perspective of overall security, while taking advantage of its strengths.

---

[27] In each section of Chapter 2, the relevant ministry or agency listed within the brackets (in the case that multiple ministries or agencies are involved, the ministry or agency in charge will be underlined) indicate which relevant ministry or agency will take the lead to engage in what measure by when.

[28] See Chapter 3, 3. (4).

[29] CSTI: Council for Science, Technology and Innovation. One of the important councils for key policies aimed at the planning, formulation, and comprehensive coordination for comprehensive and basic science, technology, and innovation policies from one position higher that respective ministries under the leadership of the Prime Minister and Minister of State for Science and Technology Policy

1. Transformation into a sustainable and resilient society that ensures the safety and security of the people

By redesigning Japan's society, achieving solutions to global issues ahead of the rest of the world, and ensuring the safety and security of the people, we aim to transform Japan into a society in which each and every one of the people enjoy diverse happiness.

To this end, we must first: (1) transform our society into one in which cyberspace and physical space create a dynamic virtuous circle, so that anyone can use data and AI anytime, anywhere with peace of mind, and maximize the use of data and AI to contribute to the resolution of global issues and reform domestic systems.

Specifically, (2) In response to global issues, Japan will reduce its greenhouse gas emissions to zero in real terms by 2050, leading the world to become carbon neutral, and building a sustainable society by promoting the transition to a cyclical economy. (3) In addition to reducing risks to the economy, society, and people's daily lives, such as natural disasters and the novel coronavirus infection, we will build a resilient society by protecting important information that is the source of national power.

In addition, (4) the government will create a new industrial base in which diverse entities, such as corporations, universities, and public research institutes will work together to create value by creating a succession of start-ups that tackle challenges driven by the needs of society, and (5) the government will develop diverse and sustainable cities and regions (smart cities[30]) across the country and around the world that will realize Society 5.0 ahead of the rest of the world in order to solve regional problems.

(6) In addition to supporting the above efforts, in order to respond to various social issues, we will strategically promote mission-oriented R&D and social implementation by utilizing the "convergence of knowledge," and create innovation. In addition, we will develop science and technology diplomacy to support social change, and strategically build international networks.

This section summarizes the items (1) through (6) above. In each of these areas, the public and private sectors will work together to develop human resources for innovation, such as those who design societies to support these efforts. In addition, we will actively contribute to the resolution of global issues as well as domestic reforms.

[Major goal]

- By redesigning our society, achieving solutions to global issues ahead of the rest of the world, and ensuring the safety and security of our citizens, we will ensure that each and every one of our citizens can enjoy diverse happiness.

[Reference index]

- The Sustainable Development Goals Report[31]
- Better Life Index[32]
- Healthy Life Expectancy
- GDP
- International Competitiveness

[30]Sustainable cities or regions that utilize new technologies such as ICT while resolving various issues faced by the city or region through the sophistication of management (planning, development, control, operation, etc.) and continue to create new values.

[31] United Nations

[32] OECD

(1) Creating new value through the fusion of cyber space and physical space

1) Recognition of the current situation

Society 5.0, which was first proposed in the Fifth Basic Plan as a vision of the future society for which Japan should aim, was defined as "a human-centered society in which economic development and the resolution of social issues are compatible with each other through a highly integrated system of cyberspace and physical space." During the period of the Fifth Basic Plan, the public and private sectors have been working together to realize this. For example, Japan has led international discussions through the proposal[33]of Data Free Flow with Trust (DFFT), the formulation of the Social Principles of Human-Centric AI[34] to promote the appropriate implementation of AI in society, and the compilation of the G20 AI Principles.[35]

However, in response to the novel coronavirus, Japan was unable to fully benefit from digitalization in all areas, including administration, education, and medical care. This could be attributed to the fact that administrative systems, such as the My Number system, were not sufficiently convenient for the people, the reform of operational processes of the national and local governments were insufficient, the lack of trust in the use of personal data, and insufficient expansion of cooperation areas among industries.

It is necessary to make efforts with a sense of urgency and speed to develop data collaboration mechanisms that create new value, to develop an environment in which players responsible for data distribution can play an active role, and to further develop the infrastructure for data utilization in Japan (such as development of digital data, cooperation between the national and local governments, standardization, and handling rules).

With regard to communication infrastructure, as the amount of data distributed over networks will increase explosively in the future, many issues such as power saving, reliability, and real-time performance have been pointed out, and drastic measures are required.

In addition, the development of trust among stakeholders is becoming the key to the promotion of data collaboration. For example, we must strongly promote the revision and digitalization of business operations to improve productivity and convenience and at the same time, resolve concerns about the use of personal data, which have been vaguely expressed by the people, and expand areas of cooperation in the industrial sector.

On the other hand, countries all over the world regard data as the foundation of national wealth and international competitiveness in the digital society, and aim to expand the amount of data and improve AI capabilities by promoting digitalization and innovation. For example, in the United States and Europe, comprehensive and concrete strategies for data have been announced over the past one to two years[36], and measures are being strongly promoted in line with these strategies. In some countries, digital twins have been built on a national scale, and the provision of highly convenient services has begun in earnest[37]. In response to this situation, countries and regions are beginning to formulate basic principles for the handling of data, and discussions are beginning in the international arena on the ideal way of a digital society. In response to this situation, the public and private sectors in Japan have been working in cooperation with each other. For example, the SIP has played a central role in the development of collaboration infrastructure in each field, such as agriculture and transportation

---

[33] Prime Minister Abe's Speech at the Annual Meeting of the World Economic Forum, January 23, 2019

[34] Decision of the Council for Integrated Innovation in March 2019

[35] At the G20 Ibaraki-Tsukuba Ministerial Meeting on Trade and Digital Economy (June 8-9, 2019), for the first time in the G20, the G20 members agreed for the first time to the AI Principles based on the concept of "human - -centered" (the "G20 AI Principles") in order to promote the development and utilization of AI, and a ministerial statement containing the contents of the Principles was adopted.

[36] Federal Data Strategy (US) (June 2019), European Data Strategy (EU) (February 2020), National Data Strategy (UK) (September 2020), etc.

[37] “Virtual Singapore" in Singapore and "India Stack" in India, etc.

infrastructure, the development of inter-field data collaboration infrastructure to interconnect them[38], and the formulation of the Smart City Reference Architecture[39] as a basic design guideline for smart cities. In addition, in order to strongly advance the digitalization of society in conjunction with the reform of systems, policies, and organizations, the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society (the IT Basic Act), which specifies policies for the formulation of measures, has been comprehensively reviewed. Moreover, the Digital Agency has been established as a new control tower, and the "Basic Policy for Reform for the Realization of a Digital Society[40]," the "Digital Government Action Plan[41]," and the "First Report of Data Strategy[42]" have been formulated, thus opening the door for Japan to become one of the world's leading countries in data utilization.

[Current situation data] (Reference index)

- State of opening of administrative service-related data (open data types): 27,635[43]
- Ratio of companies engaging in DX: 41.5% for user companies, 33.8% for IT companies (2020)[44]
- ICT market size: 99.1 trillion yen (2018)[45]
- IMD World Digital Competitiveness Ranking: 27th among 63 countries (2020)
- The number of catalog sets that can be searched by the inter-field data cooperation basis: 52,797 (including private sector: 5,535)[46]
- Number of sites providing the above catalog sets: 35 (including 1 private site)[47]
- Public metadata (by institution, program, etc.)[48] of publicly funded research data contained in research data infrastructure systems[49]
- Network development: 5G infrastructure deployment rate[50] (as of the end of March 2020, no index), 530,000 households without optical fiber (as of the end of March 2020)[51]

---

[38] A foundation for realizing distributed inter - -field data collaboration, which has functions for utilizing data safely and securely and in which the data collaboration infrastructures in various fields is are connected across boundaries

[39] Announced on March 18, 2020. A common design framework that embodies the components of a smart city and should be used as a reference for smart city promoters and stakeholders when building smart city services. It was made in the SIP second period "Architecture construction and demonstration research in cyberspace basic technology using big data and AI". https://www8.cao.go.jp/cstp/stmain/20200318siparchitecture.html

[40] Cabinet decision of December 25, 2020

[41] Cabinet decision of December 25, 2020

[42] Decision of the Digital Government Ministerial Conference, December 21, 2020

[43] From Data.go.jp as of November 27, 2020.

[44] Information-technology Promotion Agency, “IT Human Resource White Paper”

[45] Ministry of Internal Affairs and Communications, "Information and Communications White Paper 2020"

[46] As of October 2020

[47] As of October 2020

[48] Chapter 2, 2. (2) states that systematic metadata will be added to research data obtained from public funds by FY2023, and that a system will be established from that year in which these metadata can be searched on the research data infrastructure system.

[49] The Research Data Infrastructure System (NII Research Data Cloud) described in Chapter 2, Section 2 (2), began full - -scale operation in fiscal FY2020 as a core platform for managing and utilizing research data using public funds.

[50] The ratio of the number of 5G advanced specified base stations to the total number of meshes divided into about 4,500 in 10 km square nationwide.

[51] As of the end of March 2020. Ministry of Internal Affairs and Communications survey.

- Recognition of Society 5.0, expectations and concerns about services: recognition rate 12.9% (2019) [52]
- Number of accredited education programs under the mathematics, data science and AI education program accreditation system
- R&D expenditure in the information and communications field: 2,362.4 billion (FY2019) [53]

2) Ideal form and direction for realizing it

For the realization of Society 5.0, in order to create new value by combining cyber space and physical space, we aim to transform into a society that creates a dynamic virtuous cycle that constantly changes. In this way, a digital twin with high-quality and diverse data is created in cyber space, and physical space is changed based on this digital twin while actively using AI, and the results are reproduced in cyber space.

To this end, under the command tower and national strategy for realizing a digital society, the government will build a sustainable and resilient society that ensures the safety and security of the people by building and thoroughly utilizing this new social system infrastructure while reviewing necessary regulations, and taking on global issues and domestic system reforms. In addition, it is necessary to build a rational cyber space based on the overall architecture from strategy to infrastructure and human resources, and to continuously reform business operations in physical space and the industrial structure on the premise of its utilization.

Human resources and social infrastructure will support such a society. We will train a large number of human resources with knowledge of mathematics, data science, and AI who will play an active role in all fields of society. We will also implement technologies that utilize data and AI in an environment where next-generation infrastructure has been established all over Japan. Through these efforts, we will build a foundation on which anyone, anywhere, anytime, can use data and AI to create services that have never been realized before.

In addition, administrative organs will play the role of a data holder platform to develop a base registry[54], standardize data related to administrative services, and open it to the private sector. In the fields of education, medical care, disaster prevention, etc., the government and the private sector will work together to utilize a safe, secure, and reliable data platform developed by the national government to build a digital twin in cyberspace based on a wide variety of data on all goods and services.

In addition, by establishing a reliable data distribution environment, ensuring security and privacy, and establishing fair rules, etc., companies will mutually provide and utilize data, and highly convenient services that support people's convenience and safe lives that are developed and provided in various fields will be activated. Such establishment will also address the negative aspects and ethical issues, etc. that accompany data and the social implementation of AI. Participation of various people in society will also be promoted, accelerating the development of domestic and foreign societies.

In response to these changes, business reforms and digitalization based on the use of data in all areas of business in all fields will advance, industrial structure reforms and international industrial competitiveness will improve, public acceptance of data utilization and awareness of cooperation by corporations will increase, and a virtuous cycle will emerge in which data utilization will further advance across borders.

By realizing such a society, Japan will support efforts to build a sustainable, safe and secure society and to resolve various social issues. Japan will also communicate to the world its vision of realizing Society 5.0 ahead of the rest of the world.

---

[52] From the Fifth Science and Technology Basic Plan Review (August 2020))
[53] Science and Technology Research Survey Results 2020, Ministry of Internal Affairs and Communications (December 2020)
[54] Basic social data such as persons, corporations, land, buildings, qualifications, etc., which are registered and disclosed at public institutions, etc. and are referenced in various situations

[Target]

- By completing the Data Strategy, we will transform society into one in which cyberspace and physical space create a dynamic virtuous circle, and anyone can create new value anytime, anywhere by utilizing data and AI with confidence.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Create an environment where anyone, including startups and researchers, can collaborate and connect data across fields
- Disaster prevention field: Disaster response utilizing SIP4D[55] will be possible in all prefectures
- Smart Cities: Around 100 local governments and regions (including startup / ecosystem hub cities)

3) Concrete measures

a. Strategies and organizations for building cyber space

- Under the Basic Policy for Reform for the Realization of a Digital Society, we will launch a Digital Agency during 2021 as a control tower for the formation of a digital society, which will have a powerful comprehensive coordination function (advisory authority, etc.), form plans, and will manage and supervise information systems[56] of the national government, local governments, quasi-public departments, etc., as well as develop important systems by itself. [IT] [57]We will review regulations from the viewpoint of promoting the formation of a digital society. [IT, Regulations Office, and relevant ministries and agencies]
- We will clarify the action principles of each player, including administrative organs and the private sector, regarding data, and confirm the progress of measures taken by the relevant ministries and agencies from FY2021, starting with the formulation of the First Report at the end of FY2020, with regard to data strategies for building cyberspace and creating new business and administrative services using data, and constantly review and implement them. [IT, STI]

b. Development of data platforms and provision of highly convenient data utilization services

- With regard to the base registry (individuals, corporations, addresses, land, offices, etc.), which will be the basis of data utilization services, the relevant ministries and agencies of the data holder and the IT Headquarters will cooperate to examine the direction of development by June 2021. Some of the preceding projects will start operation by the end of FY2021, and the development of data standards will be sequentially implemented. [IT, relevant ministries and agencies]
- We will enable each citizen to enjoy the same level of detailed administrative services and to perform procedures online in both regional and urban areas. For this purpose, the government will promote integration and unification of government information systems while ensuring mutual cooperation through standardization and unification, and promote the reform of administrative services and operational systems from the users' point of view in an integrated manner while facilitating cooperation with private systems. By doing so, we will further improve the convenience of citizens and businesses and reduce operating costs (by 30% by FY2025 compared to FY2020). The government will also promote standardization and

---

[55] See Chapter 2, 1. (3).

[56] For local governments and quasi-public departments, etc., limited to systems for which subsidies from the national government are granted.

[57] After the launch of the Digital Agency in 2021, the Digital Agency will handle operations. Hereinafter the same applies.

commonization of information systems[58] pertaining to 17 operations of local governments and aim to shift to information systems conforming to standards (standard specifications) by FY2025. Based on the effects of standardization and cloud computing, the government will aim to reduce operating costs of local governments' information systems by at least 30% from FY2018 by FY2026, when the shift to standards-based systems is scheduled to be completed. [IT, MIC]

- In the fields of education, medical care, disaster risk reduction, etc., the government and the private sector will work together to develop and implement a data platform that will contribute to the creation of private services by 2025 in accordance with the timeline of the data strategy. At the same time, the government will aim to establish and implement measurable indicators for the development and utilization of the data platform. [IT, STI, Disaster, MEXT, MHLW, MLIT, relevant ministries and agencies]
- With regard to private services, in order to establish a data sharing platform in a collaborative area as soon as possible, IPA[59]will work on the creation of model cases by FY2021. In addition, in order to strengthen Japan's industrial competitiveness and realize safe and secure data distribution, IPA will develop and examine architectures including systems individually developed by different business and fields and standards for connecting data by FY2022, and draw conclusions in multiple fields. [METI]
- In order to solve problems related to data distribution and utilization across fields and common problems faced by relevant organizations by mobilizing the wisdom of industry, academia, and government in terms of technology, systems, and human resources to build a sustainable data ecosystem, we will build a data collaboration mechanism between fields with DSA[60] at the core in 2023. We will promote the interconnection of data infrastructure for each field, data collaboration infrastructure for smart cities and super cities, and research data infrastructure systems, which will be built on research and development issues (SIP, etc.) implemented by the Cabinet Office, and will work on raising awareness through DSA and smart cities public-private collaboration platform[61]. In addition, we will examine measures to realize more advanced data utilization in line with the expansion of the role of administrative organs as data holder platforms, the increase in international data distribution, and the development of services using data and AI. [IT, STI, Disaster, NPA, FSA, MIC, METI, MHLW, MAFF, METI, MLIT, MOE]

c. Establishing a reliable data distribution environment including data governance rules

- By the end of FY2021, we will consider the current situation, issues, and rules for the development of an environment for promoting data distribution (information banks, data transaction markets, etc.), and draw a conclusion on them. [IT, SIPSH, STI, PPC, MIC, METI]
- In order to promote the utilization of data held by the private sector, by the end of FY2021, we will consider ideal rules for the handling of data held by the private sector, such as easing the concerns of citizens and companies on the side of providing data, and improving the reliability of organizations and to which data is provided. [IT, SIPSH, PPC, relevant ministries and

---

[58] Information systems related to administrations directly related to people's lives and that require mutual connections (17 operations of Basic Resident Register Network, voter registration list management, property tax, individual inhabitant's tax, corporate inhabitant's tax, light vehicle tax, national health insurance, national pension, disabled persons welfare, late-stage elderly medical care, long-term care, child allowance, public assistance, health care, schooling, child-rearing allowance, and child and childcare support)

[59] Information-technology Promotion Agency

[60] DSA: Data Society Alliance. Established in December 2020. Called dataex.jp (tentative name) since the launch of a preparatory council for the establishment of a new organization in July 2020. Going forward, DSA will provide functions related to data connection under the name DATA-EX.,

[61] Established in August 2019 for the purpose of accelerating public and private sector cooperation for smart city efforts based on Integrated Innovation Strategy 2019 (Cabinet decision of June 2019).

agencies]

- With regard to trust services that support the data society as a whole, such as personal authentication and assurance of data authenticity, the direction of resolution will be indicated by the end of FY2021, and improvements will be made starting with those that are possible by FY2025. [IT, MIC, METI]

d. Development and R&D of next-generation infrastructure, data, and AI technologies for a digital society

- We will realize next-generation social infrastructure suitable for data and AI usage in terms of power saving, high reliability, and low delay, which will be spread like a net over the whole country. For this purpose, the development of 5G / optical fiber will be promoted. The 5G will cover 98% of the country by the end of FY2023, and the number of undeveloped optical fiber households will decrease to about 170,000 by the end of FY2021. In addition, the development and improvement of next-generation computing technologies including space systems (positioning, communication, observation, etc.), geospatial (G-space) information, SINET[62], and high-performance computing (HPC) in terms of software and hardware, quantum technology, semiconductors, and R&D for post-5G[63] and Beyond 5G[64] will be promoted.[G-space, Space, MIC, MEXT, METI]
- In addition to the development of post-5G systems and semiconductors used in such systems, the government will promote R&D by mobilizing the wisdom of both the public and private sectors by utilizing research and development funds in order to establish elemental technologies gradually from around 2025 toward the realization of Beyond 5G. [MIC, METI]
- In order to provide services tailored to each and every person making full use of next-generation infrastructure, data, and AI, we will engage in core infrastructure R&D as specified in AI Strategy 2019. [STI, MIC, MEXT, METI]

e. Human resource development for a digital society

- From FY2021, the government will accelerate dialogue between universities and the government, and industry to further enhance the system for education of knowledge and abilities, which will form the foundation of a digital society, in cooperation with industry, academia, and government, so that human resources who will play a leading role in the digital society will be produced and employed and will be able to play an active role in society. In this way, the government will foster a common understanding of the ideal way of employment and the matching of learning provided by higher education by promoting the development of a system for the early development of specialized statistical teachers, measures for the dissemination of the mathematics, data science and AI education program accreditation system, and education that emphasizes learning results using internships and PBL.[65] [IT, CBPA, NPA, MEXT, METI]

f. Contribution to the international community concerning the ideal form of the digital society

- In order to establish a global framework for data distribution, by FY2021, the government will

---

[62] SINET: Science Information NETwork. An information and communications network built and operated by the National Institute of Informatics as an academic information base for universities, research institutions, etc. across Japan.

[63] With regard to 5G, which is a next-generation mobile communications system with the characteristics of ultra-high speed, ultra-low delay, and high numbers of simultaneous connections, 5G with enhanced functions such as further ultra-low delay and high numbers of simultaneous connections.

[64] Essential infrastructure of the Society 5.0 era equipped with characteristics such as ultra-large capacity, ultra-low delay, high numbers of simultaneous connections, ultra-low power consumption, ultra- safe, and ultra-reliable that exceed 5G and post-5G.

[65] PBL: Problem Based Learning

indicate the direction of the resolution of issues that need to be addressed in promoting international data distribution, such as data quality, privacy, security, mutual trust in infrastructure, rules, and standards, and will implement measures to resolve such issues. [Cabinet Secretariat, IT, SIPSH, PPC, MIC, MOFA, MEXT]

- In order to promote international dialogue on the ideal way of a digital society, the government will lead international discussions by providing the results of good practices obtained through the above-mentioned efforts to the international arena such as the OECD, and by reflecting them in the outcomes of the G7[66] and IGF[67], for which Japan will host in 2023. [IT, STI, MIC, MOFA, METI]
- At the Expo 2025 Osaka, Kansai, Japan to be held in 2025, based on the Basic Policy on the Promotion of Preparation and Implementation Measures for World Expo 2025 (Expo 2025 Osaka, Kansai)[68], Japan will embody the Society 5.0 by utilizing data and AI. Through this, Japan will widely demonstrate its mounting capabilities both at home and abroad and attract foreign investment. [Expo, STI, MIC, METI]

g. New policy issues

- In the midst of severe changes in the social situation surrounding digitalization, measures to promote the use of data across national borders, measures to promote the construction of digital twins in the public and private sectors, measures to attract highly skilled human resources from around the world to Japan, and measures to reflect social acceptance in policies are to be reviewed according to the situation at all times using evidence. By FY2023, policies will be evaluated and reviewed, and new policies will be considered. [IT, STI]

[66] G7 Summit to be held in Japan in 2023
[67] ICF: The Internet Governance Forum. To be held in Japan in 2023
[68] Cabinet decision of December 21, 2020

(2) Promoting social change and discontinuous innovation to overcome global issues

1) Recognition of the current situation

Global social issues such as climate disasters caused by rapid climate change, increased human and economic losses due to climate change, the deterioration of biodiversity, and marine plastic waste, are becoming increasingly serious. In particular, responding to climate change is an urgent issue. It is essential to steadily implement the Paris Agreement, which has been in full operation since 2020, in order to resolve this issue, and to advance efforts aimed at realizing a global decarbonized society in the latter half of this century.

Against this backdrop, the EU, the United States, China, and other countries around the world have announced and are planning to make active investments in the development of technologies and social implementations to realize carbon neutrality[69], and this trend has been accelerated by the positioning of carbon neutrality as a pillar of economic recovery from the ravages of the novel coronavirus, as seen in the EU's Green Recovery.[70]

At the 203rd session of the Diet in October 2020, the Prime Minister expressed his intention to address the climate change issue as one of the most important issues for Japan, and to aim for a carbon-neutral society by 2050.[71] In order to aim for a carbon-neutral society that is fundamentally different from the current social structure based on economic activities that are premised on greenhouse gas emissions, social change and discontinuous innovation are essential. For this purpose, a fund worth 2 trillion yen was established to continuously support the development of innovative technologies.[72] In addition, "Zero Carbon City," local governments aiming to achieve zero CO_2 emissions in real terms by 2050, have also increased to over 300 nationwide, and efforts are being made in each region.

On the other hand, medium- and long-term resource constraints and increases in waste emissions associated with global population growth and economic development have become global issues, and efforts to achieve a circular economy are being promoted in each country.[73] Japan is also

---

[69] Under the European Green Deal, the EU formulated an investment plan in January 2020 with the aim of achieving zero greenhouse gas (GHG) emissions in real terms by 2050. Over the next 10 years, the EU and the private sector will invest approximately 120 trillion yen. The new Biden Administration of the United States will return to the Paris Agreement and will invest 0 yen in aim for net zero greenhouse gas emissions by 2050 and will invest about 200 trillion yen in decarbonization over four years. At the UN General Assembly in September 2020, China announced that it would peak out its CO_2 emissions before 2030 and aim to achieve carbon neutrality before 2060. Through the government's promotion policy, new energy vehicles and investment in renewable energy will increased.

[70] In September 2020, the EU announced its 2030 target to reduce greenhouse gas emissions by at least 55% from the 1990 level (approved by the European Council in December 2020). Over the next seven years, approximately 70 trillion yen (equivalent to 30% of the total sum of the Multiannual Fiscal Framework and Reconstruction Fund) will be allocated to the Green Recovery. In November 2020, the UK announced its Ten Point Plan for a Green Industrial Revolution, and announced plans to invest approximately 1.7 trillion yen in offshore wind power generation, hydrogen production facilities, and other measures. In December of the same year, the EUK announced a new target to reduce greenhouse gas emissions by 68% from the 1990 level by 2030.

[71] In his policy speech in October 2020, Prime Minister Suga stated, "We hereby declare that by 2050 Japan will aim to reduce greenhouse gas emissions to net-zero, that is, to realize a carbon-neutral, decarbonized society."

[72] Green Innovation Fund Project: The third supplementary budget for FY2020 is 2.0 trillion yen.

[73] For example, the EU announced a Circular Economy Package in December 2015 as the core of its growth strategy toward 2030 to actively advance the transition to a circular economic society including measures for the drastic reduction of plastic marine litter. In March 2020, the EU formulated an action plan incorporating more specific measures.

actively promoting efforts to achieve thorough resource circulation throughout the entire life cycle and the formation of a regional circulation and symbiosis zone based on the Fourth Fundamental Plan for Establishing a Sound Material-Cycle Society.[74]

With regard to the issue of marine plastic waste, which has received increasing attention rapidly in recent years, at the G20 Osaka Summit held in June 2019, leaders shared the "Osaka Blue Ocean Vision," which aims to reduce additional pollution to zero by 2050 as a first step in efforts involving emerging and developing countries.

[Current situation data] (Reference index)

- Progress of the Innovative Environmental Innovation Strategy (Innovation Action Plan, Acceleration Plan, Zero Emissions Initiative)[75]
- Number of zero carbon cities: 325 local governments (March 17, 2021)
- R&D expenditure in the environmental field: 1,289.4 billion yen (FY2019)[76]
- R&D expenditure in the energy field: 1,165.4 billion yen (FY2019)[77]
- Number of RE100 member companies (Japan)[78]: 50 (February 1, 2021)[79]
- Greenhouse gas emissions: 1.213 billion tons (FY2019 (preliminary report))[80]
- Average temperature increase in Japan: 1.24°C (1898-2019)[81]
- Resource productivity: Approx. 393,000 yen / ton (FY2017)[82]
- Market size for circular economy businesses: approximately 4 trillion yen (FY2000)[83]

---

[74] Cabinet decision of June 19, 2018

[75]The Innovative Environmental Innovation Strategy (decided by the Council for Integrated Innovation on January 21, 2020) is composed of (1) an "Innovation Action Plan" that specifies concrete cost targets for 16 technological issues, (2) an "Acceleration Plan" that specifies research systems and investment promotion measures to realize these, and (3) the "Zero Emissions Initiatives Tokyo Beyond-Zero Week" that are to be communicated and co - created together with global leaders for social implementation. A review of the Innovation Action Plan will be released as necessary as the Innovation Dashboard."

[76] Science and Technology Research Survey Results 2020, Ministry of Internal Affairs and Communications (December 2020)

[77] Science and Technology Research Survey Results 2020, Ministry of Internal Affairs and Communications (December 2020)

[78]Companies that aim to and engage in switching over the power they use to 100 percent% renewable energy..

[79] Tabulated by the Japan Climate Leaders' Partnership (JCLP) Secretariat based on the RE100 website.

[80] FY2019 Greenhouse Gas Emissions (preliminary figures) (announced by the Ministry of the Environment on December 8, 2020)

[81] Climate Change in Japan 2020 – Observations of the Atmosphere, Land, and Oceans / Forecast Assessment Report – (released by the Ministry of Education, Culture, Sports, Science and Technology and Japan Meteorological Agency on December 4, 2020)

[82] Resource productivity = GDP / natural resources, etc. input. The input of natural resources, etc. refers to the total amount of domestic and imported natural resource and imported products (direct material input: DMI). Resource productivity is an indicator that comprehensively shows how much wealth is generated with fewer natural resources, such as whether each industry is improving production activities with fewer natural resources or how things are being used efficiently in people's living, by calculating the real gross domestic product (real GDP) generated per certain amount of natural resources, etc. input. When comparing on an international scale, it is necessary to note differences in industrial structures, etc.

[83] Calculated from the FY2019 Report on the Market Scale, Employment Scale, etc. of the Environment Industry (released on July 20, 2020), Ministry of the Environment (Reference; The 4th

2) Ideal form and direction for realizing it

Japan will achieve zero emissions of greenhouse gases by 2050, carbon neutrality by 2050, and a circular economy through sound and efficient waste treatment and advanced recycling of resources. By responding to these goals, we aim to create a society that leads the world and creates a virtuous cycle of economy and environment by leading to economic growth through the development of green industries.

In order to achieve this, it is essential to redesign the economy and society through the three transitions of "decarbonized society," "circular economy," and "decentralized society" in order to reform the lifestyles of the people, the industrial structure, and the economy and society as a whole, and to resolve social issues. In addition, it is necessary to establish high goals and visions, and it is necessary for industry, academia, and government to work together widely to achieve them first towards 2030.

From this perspective, in order to realize carbon neutrality, the government will promote thorough energy conservation, electrification, and decarbonization of electricity (accelerated dissemination of technologies for maximum introduction of renewable energy and utilization of nuclear energy with priority given to safety) based on discussions at the Green Innovation Strategy Promotion Council, and will strongly promote groundbreaking innovations such as next-generation solar cells, CCUS[84] / carbon recycling, and hydrogen. In this regard, the government will promote decarbonization of people's lifestyles, realize and expand zero carbon cities, and foster public understanding in order to encourage technology introduction and social implementation, and will also consider necessary systems and standards.

In addition, by actively disseminating information on Japan's efforts and enhancing Japan's presence, we will gather the wisdom of research institutes from around the world to promote international joint research and build up supply chains. At the same time, we will attract investment in energy and environment-related businesses to Japan and promote the visualization of corporate activities.

In order to realize a circular economy, in addition to the treatment and proper management of waste, we will promote innovation such as the development of alternative materials by extending the life of products, long-term conservation and maintenance of resources, and minimization of waste generation. In addition, we will promote sustainable regional development and the transformation of people's lifestyles, while creating a regional recycling and symbiosis zone in which each region forms an independent and decentralized society by utilizing local resources such as natural resources and ecosystem services and supplements and supports each other according to the characteristics of the region.

[Target]

- As global issues become more serious, Japan's greenhouse gas emissions will be reduced to zero in real terms by 2050, leading the world to become carbon neutral and promoting the transition to a circular economy. This will contribute to overcoming climate change and other environmental problems, and will ensure sustainability based on the SDGs.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Japan's greenhouse gas emissions: real zero (2050)
- Resource productivity: Approx. 490,000 yen / ton (FY2025)
- Market size for circular economy businesses: approximately twice that of FY2000 (FY2025)

3) Concrete measures

Fundamental Plan for Establishing a Sound Material-Cycle Society (June 2018))

[84] CCUS: Carbon dioxide Capture, Utilization and Storage

a. Promotion of research and development and cost reduction of innovative environmental innovation technologies

- With regard to the Innovative Environmental Innovation Strategy, the Innovation Dashboard, the Acceleration Plan, and Tokyo Beyond Zero Week will be reviewed in a timely and appropriate manner in light of the global situation, and industry, academia, and government will steadily promote the implementation of innovative technologies in society. In addition, regarding the fields essential for achieving carbon neutrality, the government will promote the implementation of innovative technologies in society by utilizing fund projects that provide continuous support for the development of innovative technologies based on the Green Growth Strategy Through Achieving Carbon Neutrality in 2050[85] that includes (i) targets with clear time frames, (ii) research and development and demonstration, (iii) institutional development such as regulatory reform and standardization, and (iv) international collaboration, and will promote the implementation of innovative technologies in society by utilizing fund projects that provide continuous support for the development of innovative technologies. [STI, MIC, MEXT, MAFF, METI, MLIT, MOE]
- In order to maintain data interoperability and system scalability between cities and fields, the implementation of urban Oss[86] (data linkage infrastructure) in each region will be accelerated while referring to the Smart City Reference Architecture. In addition, support will be started in FY2021 to contribute to the progress of efforts for zero carbon cities so that local governments, etc. that have announced zero carbon cities will implement climate change measures using a wide variety of big data. [STI, MIC, MEXT, MAFF, METI, MLIT, MOE]
- The government will accelerate necessary R&D to achieve the 2050 goals of the Moonshot Research and Development Program ("Realization of Sustainable Resource Circulation for Global Environment Restoration" and "Creation of a Sustainable Food Supply Industry with No Excess or Waste on a Global Scale through Full Utilization of Unused Biological Functions"), and will clarify the path toward social implementation. [STI, MAFF, METI]
- In cooperation with the international community, the government will strengthen the functions of the "Innovative Global Research Centers" such as the AIST Global Zero Emission Research Center, the Next-Generation Energy Infrastructure Research Center, and the Tokyo Bay Area Innovation Area, and activate exchanges of human resources and knowledge both in Japan and overseas. [MEXT, METI]
- By May 2021, the government will formulate the Green Food System Strategy, which will include achieving carbon neutrality by 2050 and active participation in international rule-making. The strategy will examine the development of new agricultural, forestry, and fishery policies and present a vision to be achieved by 2050. Based on this, the government will realize both the improvement of productivity and the sustainability of the food, agriculture, forestry, and fishery industries through innovation. [MAFF, relevant ministries and agencies]
- For the transition to a recycling-oriented economy, the government will promote the development of environment-friendly designs, the development of advanced recycling infrastructure technologies such as improved sorting efficiency of used products, the research and development of innovative materials with low environmental impact such as marine biodegradable plastics, and investment for the promotion of innovation. [MEXT, METI, MOE]
- While climate change is a cause of biodiversity degradation, forest ecosystems, etc., which are the basis of biodiversity, are closely interrelated and related to each other such as CO_2 sinks. Therefore, research and development will be conducted to realize carbon neutrality through synergies between biodiversity conservation and climate change measures, and the use of ecosystem functions in sinks and adaptation to climate change will be promoted. [MAFF,

[85] Released by the Committee on the Growth Strategy on December 25, 2020.

[86] Abbreviation of urban operating systems. A collective term for IT systems to realize the easy implementation of services in various fields to be introduced in smart cities and aggregate functions for regions that are attempting to realize smart cities to share, for the realization of smart cities.

MLIT, MOE]

- The government will promote efforts to save energy in social infrastructure facilities and to achieve zero emission as well as innovative technology development for reducing energy consumption at construction sites. At the same time, the government will promote the social implementation of green infrastructure that contributes to CO_2 sink measures by utilizing various functions of the natural environment.[MLIT, MOE]
- In order to contribute to the creation of highly accurate climate change prediction information and the resolution of climate change issues, the government will promote the accumulation and utilization of global environment big data such as observation data and prediction information on greenhouse gases. [MEXT, MOE]

b. Promotion of R&D and demonstration for utilization of various energy sources

- Based on the Basic Energy Plan, which is currently under review, the government will promote necessary research and development, demonstration, and international cooperation in energy conservation, renewable energies, nuclear power, and nuclear fusion. [MEXT, METI]

c. Promotion of economic and social redesigns

- With the aim of creating industries, reforming the economy and society, and solving social problems, concrete efforts will be made to redesign the economy and society through the three transitions to a "decarbonized society," a "circular economy," and a "decentralized society." In this regard, the regional perspective, which is conscious of social implementation, as well as a global perspective, is also important. Therefore, the government will promote cross-sectoral R&D to support regional decarbonization efforts, and aim to create local SDGs that will realize the three transitions in an integrated manner. [MEXT, METI, MOE]
- In preparation for COP26[87] in November 2021, the government will boldly implement global warming countermeasures such as further acceleration of technology development, implementation in society, and reform of lifestyles and work styles, based on the Plan for Global Warming Countermeasures under review. [METI, MOE]
- In order to promote the spread of technologies for decarbonization of lifestyles, the government will promote lifestyle changes and expand the prosumer of decarbonization by taking into account the discussions at the "National and Local Decarbonization Realization Conference," etc., by working on total management of housing and transportation (practical application of a combination of ZEH[88] and ZEB[89], appliances on the demand side (home electric appliances, hot water supply, etc.), local renewable energies, and EV[90] and FCV[91] as mobile fuel cells), action modification through nudge[92] and sharing, technology development and demonstration to encourage crediting of CO2 reduction using digital technologies, support for introduction, and establishment of systems.[93] [MOE, relevant ministries and agencies]
- The government will accelerate the transition to a circular economy by promoting resource recycling through such means as reducing waste emissions, improving the sophistication and efficiency of recycling processes, and turning products into biomass. At the same time, the government will aim to recover energy from waste that must be incinerated, and to separate, store, and effectively use greenhouse gases generated by processing. [METI, MOE]
- With regard to responses to biodiversity, which forms part of a distributed society, the

---

[87] 26th UN Climate Change Conference of the Parties
[88] Net zero energy house
[89] Net zero energy building
[90] Electronic vehicle
[91] Fuel cell vehicle
[92] Nudge: to gently push
[93] Prosumer: a concept introduced by futurist Alvin Toffler in his book released in 1980, *The Third Wave*. It is a portmanteau combining the words “producer” and “consumer,” meaning a consumer who conducts production activities.

government will promote research and development on technologies for the protection of endangered species and the control of invasive alien species, technologies for the monitoring, maintenance, and restoration of ecosystems including secondary nature, technologies for the assessment of economic and social values of ecosystem services including genetic resources and natural capital, and technologies for sustainable management and utilization to realize "coexistence with nature." [MOE]

d. Encouraging changes in people's behavior

- The government will promote the creation of a public understanding of the importance of individual efforts to realize carbon neutrality and the transformation of behavior to decarbonizing by utilizing the convergence of knowledge through the fusion of humanities, social sciences, and natural sciences. In particular, the government will aim to expand the market for products, services and lifestyles utilizing BI-Tech (the fusion of the knowledge of behavioral science and advanced technology)[94] by the end of FY2022. It will also aim to build a platform using blockchain technology that can freely trade individual CO_2 reduction credits at low cost. At the same time, the government will actively communicate Japan's efforts to both in Japan and overseas.[STI, METI MOE]

[94] BI-Tech: Behavioral Insights x Technology. Based on behavioral insights such as nudge, big data on the situation of energy usage by individuals / households and attribute information is collected using IoT technology and analyzed using AI technology to encourage behavioral change through personalized messages.

(3) Building a resilient, safe, and secure society

1) Recognition of the current situation

With discontinuous changes in the natural environment and in economic and social activities in recent years, the safety and security of the nation and its people are under threat. In addition to the frequent occurrence and aggravation of wind and flood damage due to climate change, etc., large-scale earthquake and tsunami disasters are expected to occur at a high probability in the near future. Under the current level of disaster prevention measures, it is difficult to prevent deaths and missing persons due to delayed escape and damage to the lives of the people and the economy and society due to damage to houses and infrastructure.

In addition, the maintenance, management, and renewal of infrastructure are extremely important as a basis for ensuring the safety and security of the people and supporting socioeconomic activities. However, as infrastructure deterioration accelerates, there are concerns about loss of functions, occurrence of large-scale accidents, and vulnerability to disasters due to insufficient maintenance caused by insufficient budget and manpower.

On the other hand, the global outbreak of the novel coronavirus has exposed the vulnerability of social systems to infectious diseases. In a globalized society, there is a risk that infectious diseases will spread across national borders in a short period of time due to the movement of people and goods across national borders. There is also a risk that new biological threats will arise in the future, which will have a major impact on people's lives and economic society.

In addition, along with the rapid expansion of cyberspace, cyber attacks have become more diverse and sophisticated through the use of new technologies and methods, and there are concerns about unexpected threats to critical infrastructure and supply chains. There are concerns about threats associated with the activation of human activities not only in cyberspace but also in outer space and marine space.

While the security environment in Japan is becoming increasingly severe, the struggle for supremacy in science, technology, and innovation is intensifying, and countries are competing fiercely in research and development of advanced technologies. Against this background, the problem of technology outflow has already become apparent, and security risks are assumed due to military diversion. In order to appropriately address this, it is increasingly important to understand, develop, and utilize technology R&D trends and important technologies from the viewpoint of ensuring technological superiority, and to control technology outflow.

[Current situation data] (Reference index)

- Number of fatalities and missing persons due to natural disasters: 114 persons (2019)[95]
- Damage to facilities due to natural disasters: approximately 1 trillion yen (2018)[96]
- Annual number of events with precipitation of ≥ 50 mm per hour: about 327 times/year (2010-2019 average)[97]
- Percentage of infrastructure more than 50 years old: (e.g.) road bridges: about 63% (2033)[98]
- Number of cyber attacks (e.g., ransomware, about 61.13 million in 2019)[99]
- Number of reported cases of infectious diseases in the Survey on Infectious Diseases (e.g.): tuberculosis: 22,448 cases (2018)[100]

---

[95] Cabinet Office, White Paper on Disaster Management 2020
[96] Cabinet Office, White Paper on Disaster Management 2020
[97] Japan Meteorological Agency, "Annual precipitation of 50 mm or more per hour nationwide (AMeDAS)" (2020)
URL: https://www.data.jma.go.jp/cpdinfo/extreme/extreme_p.html
[98] MLIT, "White Paper on Land, Infrastructure, Transport and Tourism 2020
[99] IPA Information Security White Paper 2020
[100] National Institute of Infectious Diseases, Infectious Diseases Report (2020)
URL: https://www.niid.go.jp/niid/ja/ydata/9008-ydata2018.html

2) Ideal form and direction for realizing it

In response to frequent and intense natural disasters, the government will build a resilient society in which the damage caused by delayed escape is minimized due to appropriate evacuation actions, etc., and early recovery and reconstruction of citizens' lives and the economy is facilitated by demonstrating comprehensive disaster prevention capabilities that make use of knowledge from the humanities and social sciences in addition to advanced ICT. In addition to this, the government will promote comprehensive efforts utilizing science, technology, and innovation related to national land strengthening, such as ensuring functions and soundness and reducing the risk of accidents and disasters by efficiently implementing the necessary construction, maintenance management, renewal, and improvement of infrastructure.

Furthermore, the government will ensure the safety and security of the lives of the people as well as the economy and society from attacks in new areas such as cyber space, which is becoming increasingly diverse, sophisticated, and constantly changing, and new biological threats.

Under the current situation in which geopolitical changes have occurred on a global scale and science, technology, and innovation has become the core of the struggle for supremacy, industry, academia, and government will cooperate to promote research and development of cutting-edge technologies across fields, contribute to the construction of a safe, secure and resilient society, and protect important information that is the root of national power, with the recognition that the impact of science, technology, and innovation on the state is increasing.

In order to aim for a resilient, safe, and secure society, and maintain the peace of Japan and ensure the safety and security of the nation and the people through the realization of comprehensive security against various threats, it is important for the relevant government ministries and agencies, industry, academia, and government to gather together Japan's high-level technological capabilities, and to take the perspectives of "know," "nurture," "utilize," and "protect." In other words, based on "the direction of science, technology, and innovation toward the realization of safety and security[101]," we will consider what kind of threats exist, "know" technologies that can respond to threats, consider "how to" nurture" necessary technologies, and how to implement and "utilize" those technologies in society, and we will advance efforts to "protect" those technologies. Specifically, we will clarify important technology fields that Japan should develop and allocate resources intensively to important technologies, and we will steadily implement appropriate measures against technology leakage from the viewpoint of securing and maintaining Japan's technological superiority and preventing the conversion of R&D results to weapons of mass destruction. Through these measures, we will protect important technologies for Japan, ensure Japan's research security, and realize comprehensive security.

[Target]

- To reduce and eliminate social anxiety about various threats to the lives of the people and the economy and society, such as frequent and severe natural disasters and new biological threats, and to ensure the safety and security of the people.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Number of prefectures capable of disaster response using the Shared Information Platform for Disaster Management (SIP4D): all prefectures (2023)
- Number of local governments operating disaster prevention chatbots[102]: 100 or more (2023)

---

[101] Decision of the Council for the Promotion of Integrated Innovation Strategies on January, 21, 2020

[102] A system for automatically communicating with disaster victims on SNS in the event of a disaster on behalf of humans using AI. Conducted research and development in the SIP (Phase 2) Research and Development Agenda "Strengthening National Resilience (Disaster Risk Reduction)" (FY2018 - FY2022).

- Completion of coordination between infrastructure data platforms of government ministries and agencies, major local governments, and private companies, and data coordination with other major fields by FY2025
- Establish a system infrastructure for collecting, generating, and providing cybersecurity information in Japan, and open it to industry and academia in FY2021
- Strengthening our ability to respond to biological threats: strengthen our system for collecting, analyzing, and providing information on infectious diseases, and begin collecting information as needed in FY2021. Begin providing information for risk communication based on researchers' analysis in FY2022.
- New think tank functions: launch in FY2021 and establish by FY2023

3) Concrete measures

a. Response to frequent and severe natural disasters

- In each process of prevention, observation and prediction, emergency response, and restoration and reconstruction against natural disasters, including efforts related to earthquakes and tsunamis based on international frameworks, the government will promote research and development to enhance the level of countermeasures taking climate change into consideration, as well as advance the strengthening of the observation systems and development of research facilities necessary for such research and development, and will particularly focus on strengthening resilience by utilizing advanced ICT. In addition to developing an information sharing system centered on SIP4D, which is responsible for the cross-organizational exchange of disaster prevention information, to prefectures and municipalities, the government will work to strengthen regional disaster prevention capabilities, and will promote support for decision-making in various scenes related to disaster response through the use of global environment big data utilizing DIAS[103] and the construction of an integrated G-space disaster prevention and disaster mitigation system that links efforts that make advanced use of geospatial information among relevant ministries and agencies. In addition, the government will promote the DX of disaster response by further supporting the optimization of disaster response by industry, government, academia, and citizens, and enhancing information systems for risk communication with individual citizens that contribute to self-help, mutual assistance, and public assistance. For this purpose, the government will sequentially link SIP4D with prefectural disaster information systems from FY2021. With regard to disaster prevention chatbots, part of a system for information sharing with municipalities and residents will start operating from FY2023, and efforts will be made to further enhance the system. [STI, Disaster, relevant ministries and agencies, relevant local governments]
- In addition to building a research base for information sharing systems, the government will implement efficient and effective R&D investment and social implementation based on the overall perspective of disaster prevention research, taking into account the evaluation of the level of disaster prevention measures, behavioral psychology analysis of evacuees, analysis of social needs and issues in disaster prevention , benchmarking of disaster prevention technologies, etc., utilizing knowledge from the humanities and social sciences. [STI, Disaster, relevant ministries and agencies, relevant local governments]

b. Efficient infrastructure management through digitalization

- In order to realize efficient infrastructure management for national land strengthening, the implementation of leading-edge technologies in public works will be promoted. At the same time, the digitalization and 3-D conversion of infrastructure data by each administrator will be sequentially implemented, and rules and platforms for utilizing such data will be established. [STI, MLT, relevant ministries and agencies]

---

[103] DIAS: Data Integration and Analysis System

- In order to construct collaborative data platforms in the infrastructure field, by FY2021, the government will develop an environment for collaboration between data platforms of ministries and agencies, major local governments, and private companies. From then on, the government will promote collaboration between infrastructure administrators, and will implement data collaboration with disaster prevention, urban areas, and industrial areas in order to strengthen national land and create other added value.[STI, relevant ministries and agencies]

c. Ensuring security in cyberspace where attacks are diversifying and advancing

- As cyber attacks diversify and become more sophisticated, there are discontinuous changes in the situation, and the ability to follow and adapt to such changes is required. Based on this perspective, R&D and system construction will be carried out for observing, forecasting, analyzing, responding to, and sharing information on attacks. Specifically, by FY2021, the government will build a system infrastructure for collecting, generating, and providing cyber security information in Japan, and open the system to industry and academia. In addition, the government will promote the development of advanced cryptographic technologies for the quantum computer era, and technical verification for detecting vulnerabilities and illegal functions in response to supply chain risks. [Cabinet Secretariat, STI, MIC, METI, relevant ministries and agencies]

d. Responding to new biological threats

- In response to new biological threats, the government will promote research and development related to early detection of outbreaks, understanding and forecasting of epidemics, prevention and control, and risk communication with the public. Specifically, from FY2021, the government will strengthen systems for collecting, analyzing, and providing information on infectious diseases, and will implement information collection as needed. In addition, from FY2022, the government will provide information for risk communication based on the analysis by researchers. [Cabinet Secretariat, STI, MHLW, relevant ministries and agencies]

e. Responding to threats to safety and security in the space and maritime fields

- In response to other threats to safety and security, including those in the space and maritime fields, the government will conduct R&D on leading-edge basic technologies, and R&D and social implementation in response to respective issues, while ensuring an international cooperation system. [Cabinet Secretariat, STI, Space, Ocean, MOFA, MEXT, METI, Disaster, relevant ministries and agencies]

f. Efforts to "know," "nurture," "live," and "protect" to ensure safety and security

Implement cross-sectoral efforts to respond to various important issues for realizing safety and security, and to strengthen scientific and technological capabilities that form the basis of comprehensive security while taking into account the diversity of science and technology.

- In order to enhance efforts to monitor, observe, predict, and analyze trends in threats to the lives of the citizenry and the social economy, to grasp trends in R&D at home and abroad, and to analyze issues based on knowledge from the humanities and social sciences, a new system of think tank functions related to safety and security will be established, and policy recommendations will be made on future science and technology strategies related to safety and security and on important technologies that should be developed intensively. For this purpose, a new think tank function will be established in FY2021, and an organization will be established around FY2023 to implement policy recommendations. [Cabinet Secretariat, STI, relevant ministries and agencies]
- Based on policy recommendations from new think tank functions, establish a mechanism to link with R&D programs and funding as necessary, and implement management of R&D programs, including setting clear targets for social implementation. [Cabinet Secretariat, STI, relevant ministries and agencies]
- In light of the situation in which concerns such as conflicts of interest, conflicts of duty, and

leakage of scientific and technological information are becoming more and more apparent as research activities become more international and open, the government will consider its response policy while paying attention to the difference between basic research and applied development, while also taking into account the importance of international joint research, and develop necessary guidelines such as guidelines for public invitation of competitive research funds[104] and cooperation with foreign companies in 2021. In order to support independent assurance of the soundness and fairness (research integrity) of research that should be held by researchers, the government will establish the direction of its response in early 2021 in cooperation with research communities in Japan and overseas. These guidelines will be reviewed as necessary in light of the status of efforts by each research institute, research funding agency, etc. [STI, MEXT, METI, relevant ministries and agencies]

- In order to ensure and maintain Japan's technological superiority, the government will clarify important technologies, allocate resources intensively to important technology fields, and implement appropriate measures against technology outflow. In light of the situation in which international technology outflow problems have emerged, the government will promote information gathering and consider the construction of frameworks and systems, including institutional aspects, in order to take appropriate measures against technology outflow in a phased manner according to the actual situation of various technology outflows, while promoting information exchange globally, strengthening research and innovation capabilities, and ensuring comprehensive security.

[Cabinet Secretariat, STI, relevant ministries and agencies]

[104] Of funds gained competitively from public invitations by ministries, agencies, etc. by universities, national research and development agencies, etc., those related to research (including funds considered “competitive funds”).

(4) Formation of an innovation ecosystem that is the foundation for creating new industries that share value

1) Recognition of the current situation

In recent years, large IT companies as represented by GAFA and startups have rapidly grown to the extent that they surpass large companies in a very short period of time around the world. This has become a major trend to change not only the industrial structure but also the urban structure and lifestyle. Following these large companies, many "unicorn" companies[105] have emerged around the world, mainly in the United States and China, and they are taking the lead in each country's markets. Advanced countries are also strategically forming their startup ecosystems to create innovative startups.

In addition, existing large enterprises are also required to break away from "self-sufficiency" and engage in open-type and disruptive[106] innovation in cooperation with startups that take on challenges by taking advantage of mobility in various fields and universities with innovative technological seeds.

On the other hand, in Japan, closed-type and linear-type innovations, mainly by existing business companies, have become the mainstream, and startups have not been able to play an active role. Even if startups try to grow, there are problems such as lack of funds before and immediately after startup (seed and early periods), lack of management human resources, difficulty of collaboration with business companies, lack of initial demand creation, and lack of creation of startups from universities and national research and development agencies. Therefore, the innovation ecosystem that creates startups is not fully developed.

For this reason, in July 2020, Japan selected Startup Ecosystem Hub Cities[107], and is promoting the formation of an autonomous startup ecosystem comparable to those in the world. In addition, we are advancing the formation of Tsukuba Science City and Kansai Science City as open innovation hubs where various entities such as corporations, universities, and public research institutes can collaborate and co-create.

[Current situation data] (Reference index)

- Number of university start-ups: 204 from universities, etc. (established in FY2019), 13 from research and development agencies (established in FY2018)[108]
- Amount and number of VC investments: annual amount of VC investments: 289.1 billion yen / 1,824 (FY2019)[109]
- Cross-border trademark and patent applications: Japan is the only major country with a relatively larger number of patent applications than trademark applications per unit population[110]

---

[105] Unlisted venture companies with a corporate value of $ 1 billion or more, 221 in the United States and 109 in China (as of March 2020), and eight in Japan (calculated by the Cabinet Office based on JAPAN STARTUP FINANCE REPORT 2018, 2019).

[106] "Disruptive" here refers to innovations that bring about dramatic changes in the order of existing markets.

[107] Based on the "Beyond Limits. Unlock Our Potential - -A Strategy to Build Startup Ecosystem Hubs that Compete with the World" (decided by the Cabinet Office, MEXT, and the METI in June 2019), this is a system to build hubs in cities with the accumulation and potential of startups are approved, and relevant ministries and agencies provide priority support for such efforts. In July 2020, eight cities were selected as global hub cities:: Tokyo area, Nagoya / Hamamatsu, Kansai area, and Fukuoka, and as promotional hub cities, Sapporo, Sendai, Hiroshima, and Kitakyushu.

[108] Survey by MEXT and Cabinet Office

[109] Venture Enterprise Center (VEC), "Venture White Paper 2020"

[110] MEXT National Institute of Science and Technology Policy, "Science and Technology Indicators 2020" (survey material 295, August 2020)

- Mobility between sectors of researchers: 1,150 researchers transferred from companies to universities and 218 researchers transferred from universities institutions to companies (FY2019)[111]

2) Ideal form and direction for realizing it

We aim to create a society in which a new industrial base has been established in which corporations, universities, and public research institutes work mutually while securing diversity to create value by creating a succession of startups that strive to solve problems using the needs of society as a driving force.

For this reason, R&D results from universities, national research and development agencies, etc., which take into account the needs of cities, regions, and society, are commercialized through open innovation with start-ups and business companies, etc., and form a cycle (positive cycle) in which new added value is continuously created. By this cycle actively functioning with social needs as a driving force, products and services that are applicable to the world are created. In addition, funds obtained through business success and knowledge obtained through experience accelerate human resource development and joint research by business companies, universities, national research and development agencies, etc., thus forming an ecosystem in which universities, national research and development agencies, business companies, local governments, etc. are closely connected and start-ups that create innovation are created and grow large one after another.

The formation of a system that seamlessly links these flows at the core of cities and regions creates continuous and interconnected innovations that lead to solutions to social issues and social changes, as well as global expansion of startups and increased global investment.

In order to realize such an ecosystem, the creation of needs-pull type innovation will be strongly promoted, and the institutional and policy environment will be improved in order to promote the innovation activities of start-ups and operating companies. Furthermore, in order to make use of the knowledge of universities and national research and development agencies to meet the needs of society, the creation of new value co-creation through industry-academia-government collaboration and the formation of start-ups and ecosystem hub cities will be promoted, and human resources development to support the ecosystem will be promoted.

[Target]

- Universities, research and development agencies, business companies, local governments, etc. are closely connected to form an ecosystem in which a succession of start-ups that strive to solve social problems and change are born one after another, and new values are continuously created.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Target expenditure for startup, etc. based on SBIR[112]: 57 billion yen (FY2025)[113]
- Target for contracts with new business operators with less than 10 years of business establishment based on the Public Agency Act: 3% (FY2025)[114]
- Number of participants in practical entrepreneurial education program: 1,200 (FY2025)[115]
- Amount of joint research received by universities and national research and development agencies from private companies: By FY2025, increase by approximately 70% from FY2018

---

[111] MIC, Science and Technology Research Survey Results 2020 (December 2020)
[112] A cross-sectoral system in ministries and agencies that aim to increase opportunities for spending such as R&D subsidies toward small- and medium-sized corporations and support the commercialization of the outcomes thereof (SBIR: Small Business Innovation Research).
[113] FY2020 target, about 46.3 billion yen
[114] FY2019 performance, 1.06%
[115] FY2020 forecast, about 600 persons

(FY2025)[116]

- Percentage of startup ecosystem hub cities with examples of linking and connecting data across sectors: 100% (2025)
- Number of unlisted venture companies (unicorns) or listed venture companies[117] with a corporate value or market capitalization of $ 1 billion or more created: 50 (FY2025)[118]

3) Concrete measures

a) Support for startup creation and growth based on social needs

- In order to promote the creation of needs-pull innovation by the government, the government will promote the new Japanese version of SBIR to be enforced in April 2021 in cooperation with the relevant ministries and agencies. The government will introduce a research and development system based on this system from FY2021, set government expenditure targets, and provide strong support for the creation and growth of start-ups by creating initial demand by procuring products developed using this system. [STI, relevant ministries and agencies]
- In order to realize the creation and effective support of start-ups that solve social issues and bring about game changes in the market, the government will develop an environment to promote the creation of start-ups originating from universities, national research and development agencies, etc., support the formation of venture capital funds, and provide large-scale financial support (Gap Fund supply) by research fund. [MEXT, METI]
- In order to ensure that appropriate contracts are made from the perspective of promoting open innovation and ensuring a fair and free competitive environment when startups collaborate with large enterprises through joint research, etc., guidelines will be formulated that summarize problem cases in each contract, directions for concrete improvement thereof, and views under the Antimonopoly Act. [Fair Trade, METI]
- The government will continue to ascertain whether appropriate cooperative relationships have been established between university-based start-ups and related companies. [STI, METI]
- We will create an environment in which candidates for managerial positions can easily change jobs at promising start-ups whose growth has been hampered by a shortage of managerial positions by, for example, arranging requirements for managerial positions in light of startup management issues. [METI]
- In cooperation with government-related organizations providing startup support, the government will continue to support startups that engage in commercialization, etc. by utilizing technological seeds, and researchers and entrepreneurs who aim to start businesses. [METI, relevant ministries and agencies]

b. Promotion of corporate innovation activities

- In order to ensure that companies that take on innovative management[119] are evaluated by the capital market, etc., the government will design a system to issue stocks based on

---

[116] It is estimated to be about 88. 2 billion yen in 2018. The government will consider reviewing the numerical targets as necessary, taking into account the situation in the first half of the Sixth Basic Plan period (including the recovery from the effects of the novel coronavirus) of the amount of joint research received.

[117] As of the beginning of FY2018, companies that have not been established or have been established for less than 10 years are eligible.

[118] The target from FY2018 to FY2025 was set in the Action Plan for Innovative Business Activities 2020 (July 17, 2020). As of the end of FY2019, there are 16 companies..

[119] Management to transform organizations, processes, corporate culture and climate and to facilitate innovation; provided, however, that it is assumed that a system has been established to allocate necessary resources (budget, personnel, etc.) for innovation creation activities and to commercialize them.

ISO56002:2019[120], the Action Guidelines for Japanese Companies' Management for Value Creation Formulated[121], etc. In addition, in funding research and development, the government will sequentially conduct examinations taking into account the status of efforts by companies based on the Action Guidelines, the Guideline for Enhancing Industry-Academia-Government Collaboration Activities, etc.[122]

- Based on the diversity situation in which external human resources re active in European and North American companies, the efforts of countries and companies around the world, and the results of analyses of past R&D projects conducted in FY2020, the government will establish new policy methods for promoting R&D in R&D projects in a flexible manner in accordance with new social issues, rather than in a linear manner. [METI]
- We will promote understanding of the management importance (value and risk) of open source software (OSS)[123], which is essential for creating open and agile innovation, and conduct dissemination and awareness raising to raise awareness of the use of OSS.[124] [SIPSH]
- By FY2024, the government will consider and draw up a conclusion on methods for compiling statistics to grasp detailed R&D trends in enterprises, such as R&D periods. [STI, MIC, METI]

c. Promotion of new value creation through industry-academia-government collaboration

- In order to accelerate the matching of knowledge, which is the source of innovation owned by universities and national research and development agencies, with social needs, the promotion of industry-academia-government joint research and the strengthening of young researchers and industry will be strengthened. [STI, MEXT, METI]
- The government will promote the creation of new value through industry-academia-government collaboration by disseminating to universities and industries the issues and prescriptions in universities and industries that were compiled in the Industry-Academia-Government Collaboration Guidelines in June 2020. In addition, the government will promote the examination of research and development projects for promoting industry-academia-government collaboration that brings about a virtuous cycle of human resources, knowledge, and funds, taking into account the status of efforts by universities and enterprises based on the Industry-Academia-Government Collaboration Guidelines. [STI, MEXT, METI]
- The government will promote cooperation among universities, national research and development agencies, research institutes, companies, etc. by promoting the establishment of a management system that supports the formation of sustainable industry-academia-government cooperation projects and the advancement of projects, and the development of open innovation centers that serve as venues for co-creation by various stakeholders. [STI, MEXT, METI]

d. Building a world-class startup ecosystem

- To support the unique efforts of the startup ecosystem hub cities to form an autonomous startup ecosystem comparable to that of the world, the government will provide intensive support to the hub cities by the public and private sectors, such as vitalizing the creation of startups at universities, strengthening accelerator functions and the Gap Fund with a view to enter foreign markets as well, raising awareness of the connection of data between sectors to the foundation,

---

[120] International standard for innovation management systems (July 2019)
[121] October 4, 2019, Ministry of Economy, Trade and Industry and Innovation 100 Committee
[122] Guideline for Enhancing Industry-Academia-Government Collaboration Activities [Supplement] (June 2020)

[123] OSS: Open Source Software. Software that the creator of the software has published the source code free of charge and is users are permitted to use, modify, or redistribute it under prescribed conditions.
[124] Utilizing the results of the "Survey and Research on Intellectual Property Risks Related to Open Source Software in the Age of Digitalization and IoT" (April 2020, Japan Patent Office)

and cooperating with smart city projects. [STI, MEXT, METI]

e. Development of human resources to take on challenges

- In order to develop human resources who are motivated to take on the challenge, by FY2025, all universities participating in the consortium of startup ecosystem bases will implement an online and other entrepreneurship programs. By the same fiscal year, these examples will be collected and deployed nationwide. [MEXT]
- The government will create opportunities for the development and active participation of innovative human resources in order to increase the depth of a diverse range of innovative human resources, including management human resources involved in the creation of innovation, and to improve the quality of human resources by increasing their mobility. To this end, the government will, by FY2023, engage in conducting a fact-finding survey on the development of an environment for developing innovative human resources and disseminate best practices, taking into account the accumulation of discussions on human resource development. [METI]
- From the perspective of promoting human resource exchanges between universities, national research and development agencies, and corporations, allowing innovative human resources to work in the right place, and enhancing the efficiency of innovation creation, the Basic Framework of the Cross-appointment System and Points to Note (Supplementary Version) will be widely disseminated to industry and academia by FY2023, and efforts will be made to match industry and academia human resources by utilizing the "Public and Private Support Project for Discovering Young Researchers." [METI]

f. Continuation of R&D and succession of technologies related to important technologies that need to be retained in Japan

- In the event that it becomes difficult for operating companies to continue research and development R&D or technologies due to environmental changes such as the novel coronavirus pandemic, with regard to important technologies that are highly necessary to be retained in Japan, efforts will be made to establish a framework, such as national research and development agencies to take over such technologies, including research resources, with a view to bridging the future. [METI]

(5) Urban and regional development (development of smart cities) as the foundation for succeeding to the next generation

1) Recognition of the current situation

In the world, various smart city concepts have been proposed to solve problems such as energy, environment, transportation, health and medical care, education, and natural disasters, which have become serious problems that threaten the survival of cities and regions due to population concentration, consumption of resources and energy, and greenhouse gas emissions. Efforts are being made to verify and implement them in various places. Particularly in emerging countries, large-scale smart city construction plans have been announced in recent years along with the decentralization and relocation of capital functions.[125]

On the other hand, as society becomes increasingly digital, the construction of oligopolies and monopolies by IT platformer companies through data warehousing and the intensification of competition for supremacy over science, technology, and innovation among countries are seen as major issues that not only distort fair market transactions but also directly affect national security. In addition, while the concentration of personal and behavioral information is accelerating, it is required to create a balance reflecting the will of the people from the viewpoints of security assurance, trust, and public health, while giving consideration to the freedom and privacy of individuals. Against this background, in recent years, multiple cities in the world aiming at becoming smart cities have formed an alliance such as the Global Smart City Alliance, and have started activities to foster a common awareness that contributes to the effective and efficient operation of smart cities.

Smart cities in Japan are sustainable cities and regions that solve urban and regional problems and continue to create new value through the advancement of management (planning, development, management, operation, etc.) while making use of new technologies such as ICT. They are the first step toward realizing Society 5.0. Therefore, in order to solve social problems such as the aging and population decline that many cities and regions face, the widening gap between urban and rural economies and residents' services, the increase in the maintenance cost of infrastructure and transportation systems, and the decrease in business opportunities, value creation and regional revitalization through the introduction of advanced technologies are expected. Efforts for demonstration and implementation of public-private partnerships have started and are expanding. However, many of them are only at the demonstration stage within the framework of individual fields and cities, and not many regions have continued operation and implementation beyond fields and regions. This leads to a lack of public awareness about smart cities and Society 5.0.

In order for the implementation of smart cities to advance and spread nationwide, it will be necessary to accelerate the reform of society as a whole accompanied by institutional reforms also utilizing the national strategic special zones system, etc. by establishing a management organization to promote community development in response to the new era, establishing a model for collection of operating funds, utilizing data effectively through new technologies for promoting digitalization and cooperation across fields and regions, and expanding management including city planning and management by introducing and utilizing urban OSs (data cooperation infrastructure). In addition, further acceleration of digitalization and resilience of socioeconomic functions is required in response to the novel coronavirus.

For this purpose, activities involving a wide range of stakeholders and beneficiaries, such as local residents and companies, are essential. Medium- and long-term efforts are required in accordance with the issues and actual conditions of each region. Urban data and urban operating systems that support smart cities should not be monopolized by a limited number of people, but should be widely opened to local residents and new businesses on the premise of ensuring security and appropriate handling of personal information.

---

[125] New capital of Kalimantan (Indonesia), New Clark City (Philippines), new industrial city NEOM (Saudi Arabia), suburbs of Cairo (Egypt), etc.

[Current situation data] (Reference index)

- Number of types of services built on urban OSs (data linkage infrastructure): (Efforts will be made to measure from FY2021)
- Number of users providing services using urban OSs (data linkage infrastructure): (Efforts will be made to measure from FY2021)
- Regions where technologies are implemented based on government smart city projects: 23
- Number of smart city cooperation cases
- Number of dissemination and promotion activities related to community contribution and solving social problems at universities
- Number of smart city leaders

2) Ideal form and direction for realizing it

By creating diverse and sustainable cities and regions all over Japan that can solve problems in cities and regions and continue to create new value while demonstrating the potential of the region, we aim to create a society with a sustainable life base that can maximize human vitality for all stakeholders, including residents, workers, and tourists, by providing new places for life and work in remote reality in new daily lives, eliminating regional disparities, and realizing safety and security by responding to various threats such as natural disasters and infectious diseases.

For this reason, by strongly developing and implementing smart cities, which will be the core of wide-area and multilateral collaboration, starting from the construction of data collaboration infrastructure in super cities, we will create an environment in which it is easy to establish businesses by introducing and securing common systems that enable cross-sectoral data collaboration between sectors and enterprises and development and collaboration with other cities and regions. Not only in government initiatives but also in regional and private initiatives, utilization of smart city reference architectures and utilization of knowledge through smart city public-private collaboration platforms will be carried out, infrastructure management methods using new technologies and next-generation mobility services will be introduced, and overall optimization of urban activities using open data in various fields will be realized.

In this way, community development with the participation of citizens will advance, and activities rooted in the community will be activated through collaboration with the human resources who lead the efforts. This will create many industries, and successful experiences will trigger the next challenges one after another, and efforts to return local knowledge to society through industry-academia-government collaboration will be activated. Additionally, we will advance the substantiation of images of diverse cities and regions that harness and foster the characteristics and activities of each city or region while undertaking to solve social, economic, and environmental issues, such as human-oriented compact urban development and community development that aims for smart local governance. Through this, various sustainable cities and regions will be formed in various places that enhance social value, economic value, environmental value, etc., such as improvement of residents' satisfaction, activation of industry, optimization of greening and resource utilization, and realization of symbiosis with nature. In addition, smart cities that are realized in various forms depending on the social and natural resources of cities and regions, such as cities that provide cutting-edge services and regions that coexist with nature, such as *satoyama* and *satoumi* (socio-ecological production landscapes and seascapes), will cooperate with each other to form a supporting network and become a dynamic mechanism that creates a positive cycle, which will lead to the realization of Society5.0.

In addition, Japan will contribute to the realization of a decarbonized society and regional circulation and symbiosis zone to be handed over to the next generation, as well as the achievement of the SDGs, by promoting the sharing of smart cities and values among countries around the world, through the recognition of Japan's efforts and concepts of smart cities as a problem-solving developed country as a global norm.

At the 2025 Expo 2025 Osaka, Kansai, Japan, Society 5.0 will be presented to the world, embodying the concept of "Designing Future Society for Our Lives," which presents an ideal society after overcoming the novel coronavirus.

[Target]

- The smart cities embodying Society 5.0 are developed across the country and they involve the participation of various stakeholders including citizens to resolve regional issues. Diverse and sustainable cities and regions that enhance social, economic, and environmental values will be formed across Japan, and Japanese concepts will be disseminated to the world.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Number of smart cities implemented (number of local governments and regional organizations that implement technology and link and connect data between fields): approximately 100 (2025)
- Number of local governments, private enterprises, and regional organizations engaged in smart cities (members and observers of the smart city public-private partnership platform): 1,000 organizations or more (2025)
- Support for projects to acquire and utilize advanced digital technologies and systems overseas (smart cities, information infrastructure spanning multiple fields, advanced ICT, AI, etc.): 26 projects (2025)[126]

3) Concrete measures

a. Development of infrastructure to facilitate data utilization and development of urban OSs capable of data collaboration

- In the smart city-related projects in which government funds are involved, in the development and service development of urban OSs (data collaboration infrastructure) by local governments, etc., the introduction and service development of urban OSs (data collaboration infrastructure) capable of data collaboration referring to the smart city reference architecture shall be promoted. In addition, the connection with urban OSs (data collaboration infrastructure), etc. established in other regions shall be promoted, and disclosure of APIs for data collaboration shall be requested. [OPDVLE, STI, MIC, METI, MLIT]

- Through the implementation of smart city-related projects by ministries and agencies, the development of interoperable services that can be deployed across regions will be carried out by 2025, and the relationship between infrastructure and services will be organized so that services developed in leading regions can be deployed in other regions. [OPDVLE, STI, MIC, METI, MLIT]
- The government will revise the Smart City Security Guidelines created in 2020 as needed, promote domestic deployment, and support security in the construction of smart cities. [MIC, METI]

b. Development of smart city creation cases nationwide with super cities as the core of collaboration

- Based on the revision of the National Strategic Special Zones Act of 2020 and the revision of the Basic Policy on National Strategic Special Zones, zones will be designated in 2021. The designated super cities will be positioned as "total future cities" that solve regional problems with state-of-the-art technologies, and advanced services will be implemented. [OPDVLE]
- By FY2025, cases of super cities and smart cities will be collected, cases and progress status of initiatives will be grasped and shared through smart city public-private partnership platforms, etc., and collaboration of smart city-related projects across the country will be advanced, and

[126] Under the ASEAN Smart City Network (ASCN), Japan aims to provide assistance to 26 cities in 10 ASEAN countries, that are aiming to promote projects through collaboration with private companies and foreign countries.

regional and private initiatives will be promoted. Particularly in ordinance-designated cities and core cities, etc., implementation will be promoted referring to precedent cases, and multilateral collaboration among cities and wide-area collaboration with surrounding areas will be promoted. [OPDVLE, STI, MIC, METI, MLIT]

- Based on the Smart City Guidebook, which is a guide for promoting smart cities in local governments and regions, prepared by the end of FY2020, the government will promote reference architectures, APIs, and services, share examples of smart cities, and disseminate and develop the significance, promotion methods, and definitions of smart cities. [OPDVLE, STI, MIC, METI, MLIT]
- In order to implement and disseminate smart cities in a planned manner, the promotion system within the government shall be strengthened, and projects by each ministry and agency shall be carried out in an integrated manner based on a common policy. In addition, efforts shall be made for further cooperation with the government-wide efforts to realize a digital government and to develop a data cooperation infrastructure. This will lead to public-private cooperation efforts such as promoting the creation of local start-ups using open data of the national and local governments and solving local problems, on the assumption that administrative organs, which are the largest platforms of the whole country, will build open systems that can be linked to the private sector through open and standardized APIs, by utilizing base registries built on data strategies. [STI, relevant ministries and agencies]
- With regard to the formation of diverse and sustainable cities and regions that enhance social, economic, and environmental values through the use of smart cities, including the improvement of residents' satisfaction, the revitalization of industry, the optimization of greening and resource utilization, and the realization of symbiosis with nature, the addition of assessment indicators will be considered by 2021. At the same time, they will be reviewed as necessary and their survey analysis methods evaluated. Utilizing knowledge in various fields such as research and development of a total optimum model using mathematical applications and the examination of analytical evaluation methods, the future vision of smart cities that should be aimed for in the future will be materialized toward the realization of Society5.0, such as cities that provide cutting-edge services and areas that coexist with nature such as *satoyama*. [Social System, OPDVLE, STI, MIC, MTI, MLIT]

c. International development

- At the G20 Global Smart City Alliance, we will promote cooperation with cities around the world through dissemination and public relations activities under the concept of "free and open smart cities." [STI, METI]
- By 2021, the government and the private sector will establish a system to transmit information in cooperation with the international framework. In addition to transmitting the concept of Japan's smart cities, the government and the private sector will develop Japan's experience in urban infrastructure development and data management know-how overseas, mainly in Asia. [Cabinet Secretariat, STI, MIC, MOFA, METI, MLIT]
- In FY2021 and beyond, the government will continue to promote the use of international standardization related to smart cities in cooperation with experts on standards in Japan and overseas, targeting reference architectures and security guidelines. [Cabinet Secretariat, OPDVLE, STI, SIPSH, MIC, MOFA, METI, MLIT]
- With regard to the Expo 2025 Osaka, Kansai, Japan to be held in 2025, by implementing projects that also contribute to smart cities based on the Basic Policy on the Promotion of Preparation and Implementation Measures for World Expo 2025 (Expo 2025 Osaka, Kansai)and will actively promote Society 5.0, which embodies "Designing Future Society for Our Lives." [Expo, STI, relevant ministries and agencies]

d. Developing next-generation human resources for sustainable activities

- The basic knowledge and specialized knowledge necessary for the realization of smart cities will be collected. By the end of FY2021, the requirements for human resources engaged in planning, construction, and operation will be sorted out, and a human resources development

system will be established in accordance with their roles and levels. Based on this, information on human resources will be provided to reduce anxiety and distrust in technology. At the same time, a place for joint creation of industry-academia-government collaboration centered on universities will be formed. [STI, MEXT]

- By the end of FY2021, the government will gather information on leading personnel (architects) who can coordinate the overall design of smart cities, and support their development, deployment, and activities in local communities. [STI]

(6) Promotion of research and development and social implementation to solve various social problems and utilization of the convergence of knowledge

1) Recognition of the current situation

Japan faces a wide range of social issues, including the declining birthrate and aging population, urban and local issues, and resource issues such as food, as well as issues such as responding to global issues and building a resilient, safe, and secure society, which have been taken up in the previous section. Society and the public have high expectations for science, technology, and innovation policies.

In other countries, large-scale social changes are taking place not only in the emergency response to the coronavirus pandemic, but also in the creation of future industries such as so-called green recovery, and in research and development and large-scale investment from the viewpoint of security. On the other hand, Japan's research and innovation capabilities, especially the driving force for the implementation of advanced technologies into society, are not sufficient, and its international competitiveness in the business field is significantly declining.

In order for Japan to respond to these complex and wide-ranging social issues, it is necessary to fulfill its international responsibilities while building strategic building strategic relationships with other countries. Japan has contributed to international discussions on digital society and global environmental issues, etc. thus far. On the other hand, Japan has not been able to actively incorporate the knowledge and social needs of the world, construct a strategic international network centered on Japan, and disseminate and spread Society 5.0 to the world.

Now is the time Japan to accurately analyze its strengths and weaknesses, geopolitical conditions, and overall security requirements, and steadily implement advanced technologies in society by promoting strategic R&D in important areas and by strategically utilizing intellectual property and standards, in order to resolve various social issues. It is necessary to realize discontinuous innovation that has never been seen as an extension of the past, and to achieve both economic growth and resolution of social issues by making full use of Japan's collective strength.

[Current situation data] (Reference index)

- R&D expenditure in strategic fields (AI, biotechnology, quantum technolog, materials, etc.): (Efforts will be made to measure from FY2021 results)
- Top 100 global companies by market capitalization: 47 in the U.S., 24 in China, 3 in Japan
- IMD World Competitiveness Ranking: 34th out of 63 countries (2020)
- Status of implementation of innovation in government projects, etc.
- Ratio of the number of R&D themes using the convergence of knowledge (Efforts will be made to measure from FY2021 results)
- Indicators related to social issues such as food self-sufficiency rate, export value, food waste amount, self-driving vehicle penetration rate, and number of traffic accidents
- Papers, intellectual property, and standardization by subject and field
- Public metadata (by organization, program, etc.) of publicly funded research data, etc. contained in research data infrastructure systems
- Public awareness survey on science and technology

2) Ideal form and direction for realizing it

While utilizing the convergence of knowledge through the fusion of humanities, social sciences and natural sciences, we will work together with countries, regions, international organizations, etc. (EU, G7, OECD, etc.) that share values with Japan to implement research and development and the results thereof in society in order to resolve social issues that are progressing on a global scale, domestic issues such as the declining birthrate, aging population, social insurance system that responds to changes in the economy and society, etc.. Through this, we will aim for a society in which future industry creation, economic growth, and resolution of social issues are compatible with each other by achieving structural changes in the economy and society.

In order to solve wide-ranging and complex social issues, it is necessary to improve various social systems and promote ELSI responses from the initial stage of R&D by implementing various and outstanding research results that exploit the frontiers of knowledge in society and linking them to innovation. To this end, the government will formulate strategies for the national government, ministries and agencies, implementing agencies, etc. in a systematic and consistent manner based on evidence, promote mission-oriented R&D programs and institutional reforms, and develop a system that can flexibly review strategies as necessary.

In addition, the government and the private sector will thoroughly promote the strategic and international use of standards as an important means to accelerate the social implementation of advanced technologies to solve social issues, promoting the overseas expansion of Japanese companies under international competition, and to acquire international markets. For this purpose, the government and the private sector will develop public and private sector systems. In addition, the government and the private sector will make use of public and private sector projects concerning the social implementation of science and technology and innovation and the accompanying R&D, etc., while promoting public and private sector awareness reform, so that a wide range of strategic and international uses of standards will be built in and developed in government policies and corporate management strategies.

In addition, the government will develop science and technology diplomacy, including the strategic construction of an international network between Japan and countries and regions that share common issues and values, while taking into account international responsibilities and overall security. Through this, the government will disseminate Society 5.0 to the world, while incorporating and developing the world's knowledge and diversity, and maintain and strengthen the common understanding and international competitiveness of Japan. The government will continue to produce researchers from Japan who can play a central role in international research activities, etc. its presence as an advanced nation in science and technology in research communities at home and abroad, attract excellent human resources with diverse backgrounds at home and abroad, and support the autonomous securing of the soundness and fairness (research integrity) of research in harmony with foreign countries.

[Target]

- The government will promote R&D aimed at solving social problems in Japan, such as the declining birthrate and aging population, urban and local problems, and resource problems such as food. At the same time, the government will contribute to the world as an advanced country that solves these problems, and will improve the well-being of each individual.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Promotion of the resolution of social issues: incorporate a mechanism to encourage the participation of researchers and research institutions with knowledge in the humanities and social sciences in all issues in the next phase of SIP and an implementation structure to effectively utilize the “convergence of knowledge”, and advance the social implementation of outcomes.
- Strategic construction of a science and technology international cooperation network that can maximize national interests: promote strategic science and technology diplomacy and steadily increase the number of international cooperation agreements and citations in the Top 1% papers in essential advanced fields.
- Japan's presence in the formation of international agreements, frameworks and rules: increase Japan's involvement in the development of guidelines for international organizations while steadily advancing the situation of efforts related to the international strategic use of intellectual property and standards (number of cases of efforts and support related to the formation and utilization of international standards) aimed at solving social issues and capturing international markets.

3) Concrete measures

a. Formulation and promotion of national strategy based on image of future society and evidence utilizing the convergence of knowledge

- In relation to the convergence of knowledge which contributes to comprehensive understanding and problem solving of humans and society through the fusion of knowledge in the humanities and social sciences and knowledge in the natural sciences, the basic concept and strategic promotion measures will be compiled by the end of FY2021. In addition, indicators related to the humanities and social sciences and the convergence of knowledge will be examined by the end of FY2022, and monitoring will be carried out from FY2023. [STI, MEXT]
- The government will steadily promote R&D based on the national strategy[127] in fields that should be promoted across ministries and agencies, such as AI, biotechnology, quantum technology, materials, space, ocean, environmental energy[128], health and medical care, food, agriculture, forestry and fisheries, etc. In addition, the government will review existing strategies and formulate new strategies based on evidence, while looking at the image of the future society that Japan should realize, and will concretely include clear targets, division of roles among industry, academia, and government, and ideal ways of international cooperation. In particular, the government will promote themes that are cross-sectoral and directly linked to the resolution of social issues as issues for the next SIP. [Health, STI, Space, Ocean, relevant ministries and agencies]
- With regard to the formulation of evidence-based strategies, quantitative analysis of papers, research funds, etc. and expert knowledge (expert judges) will be used to extract and analyze important science and technology areas, while utilizing the results of analyses by e-CSTI[129] and policy research institutes, etc. These will be used for the formulation of Integrated Strategies[130], the review of sectoral strategies, etc. and the formulation of new national strategies, etc. In the FY2021 Integrated Strategy, analysis will be used on a trial basis, and future utilization methods will be determined based on the results. [STI, relevant ministries and agencies]
- When embodying the vision of a future society and formulating and promoting policies, it is necessary to utilize the convergence of knowledge based on the fusion of the humanities, social sciences, and natural sciences. Instead of deciding on a single direction, it is necessary to have options for double-line scenarios and new technologies and advance while continuously conducting verification. Researchers and research institutions with knowledge in the humanities and social sciences will participate from the examination and formulation stages of science, technology, and innovation policies, including the system design of public research projects, to the verification. In addition, each research and development agency will position in the targets that the convergence of knowledge will be actively utilized in the revision of the medium- and long-term objectives, taking into account the respective missions and characteristics. [STI, relevant ministries and agencies]
- With regard to semiconductors, which are a strategic basic technology that supports the digital society, in order to respond to economic security, promote the digital revolution, and reduce power consumption, the government will formulate strategies and promote various domestic and international measures to strengthen the foundation of Japan's semiconductor industry.

---

[127] See Chapter 3 Section 2

[128] See Chapter 2 Section 1. (2)

[129] A system to accumulate STI-related data (data on input (trends of funding and human resources), activities (activities of universities, research and development agencies, etc.), output (papers, patents, etc.), and outcomes (economic and social trends) and enable easy analysis by policy-makers and business operators.

[130] Strategy that indicates the measures on which the government should focus in particular each fiscal year based on the Basic Plan and considering the changes in the situation each year.

[METI]

- With regard to the robots that will take on the role of connecting cyberspace and physical space in the Society 5.0 era, based on the Plan for Promoting Social Change Taking Advantage of Robots[131], industry, government, and academia will cooperate to promote efforts for building a robot-friendly environment that makes implementation easy, building a human resources development framework, building a R&D system that responds to mid- to long-term issues, and open innovation that accelerates social implementation. [MIC, MEXT, MAFF, MHLW, METI, MLIT]
- In order to develop an environment where industry, academia, and the public and private sectors can jointly use high-precision and high-value geospatial information, and to realize a G-space society in which these are highly utilized, the next Basic Plan for the Advancement of Utilizing Geospatial Information will be formulated by the end of FY2021. [G-Space]

① Promotion of mission-oriented R&D to resolve social issues

- With regard to social issues such as infectious disease countermeasures, low birth rate and aging population, global environmental problems, disaster prevention, regional revitalization, reduction of food waste, resources, and energy that Japan and the rest of the world are facing, the government will take into account the needs of Japan and overseas, and based on the analysis of various data that are continuously observed and collected, the government will establish a specific mission to resolve the issues with the participation of various sectors including citizens, and will promote R&D in various frameworks including the next SIP. [STI, relevant ministries and agencies]

- With regard to the Moonshot Research and Development Program established in 2018, the government will take advantage of the knowledge acquired through Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST) and the Impulsing PAradigm Change through disruptive Technologies (Impact), which the government has been engaged in until now. The program aims to attract people by setting ambitious goals and concepts for social issues that are difficult to achieve but are expected to have a major impact. Under the direction of top researchers who lead the cutting-edge research, the government gather the knowledge of researchers from around the world and steadily engage in R&D to achieve these goals. The government will also actively promote challenging R&D to draw out basic research capabilities to the maximum extent, and will seek to discover and develop innovative research results while allowing for failure. Furthermore, the government will also renew the management methods to a form that enables flexible review of the program and contents by looking at the whole relevant R&D while always keeping in mind the evolving world R&D trends. The government will also thoroughly implement an open and closed strategy with a view to commercialization in the future. This new research method will realize disruptive innovation. If necessary, the government will also enhance efforts by setting new goals. [Health, STI, MEXT, MHLW, MAFF, METI]

- In order to solve social problems in Japan and the world and create new value through science, technology, and innovation, from FY2021, the government will strengthen funding for R&D targeting issues that require responses using the convergence of knowledge through the fusion of humanities, social sciences, and natural sciences, such as citizen participation in ELSI responses from the initial stage of R&D. [MEXT]
- A new corporation shall be established under the responsibility of the national government with regard to the International Educational and Research Center, which will play a central role in research and development and human resource development indispensable for the creative reconstruction of Fukushima. The existing facilities shall be reorganized, the

[131] Report by the Council for Promoting Social Change Taking Advantage of Robots (July 2019)

organizational form shall be on the national research and development agencies, and the basic concept of the new center shall be formulated in FY2021. [Reconstruction, relevant ministries and agencies]

② Social implementation of advanced science and technology to solve social problems

- With regard to issues that are important for Japan's economic and industrial competitiveness and are related to multiple ministries and agencies, a large-scale industry-academia-government collaboration system will continue to be established, and comprehensive R&D will be promoted, including institutional reforms, to realize social implementation while utilizing the convergence of knowledge. For this purpose, the ideal state of national projects such as the next SIP and how to deploy SIP-type management in projects by other ministries and agencies will be examined in 2021, and will be reflected in future projects. Some issues such as self-driving in the second phase of SIP have already been studied in the field of humanities and social sciences, and such efforts will be developed in FY2021 onwards. In addition, in order to improve the feasibility of solving social issues, the next SIP will require the incorporation of a mechanism to promote the participation of researchers and research institutes with expertise in humanities and social sciences and an implementation system to effectively utilize the convergence of knowledge in all issues, and its activities will be evaluated. [STI]
- Candidates for the next SIP will be examined toward the end of 2021 in order to strengthen the control function of CSTI. Specifically, CSTI will identify social issues to be addressed in the medium term based on the Sixth Basic Plan, the Integration Strategy, and various sectoral strategies formulated by the Integrated Innovation Strategy Promotion Council. Among these social issues, research and examination will be conducted on technology development themes to be addressed across ministries and agencies utilizing the convergence of knowledge. [STI]
- For the respective issues of the second phase of SIP, the government will advance R&D including on building a system for social implementation towards the social implementation of the outcomes as well as conduct follow-up investigation and follow-up evaluation after the end of the project and confirm the realization status of the social implementation of the outcomes. [STI]

- With regard to Public/Private R&D Investment Strategic Expansion ProgramM (PRISM[132]), CSTI will continue to promote the expansion of public and private R&D investment and the implementation of PRISM in society by guiding the measures of each ministry and agency and accelerating projects based on the integration strategy and various strategies for each field formulated by the Integrated Innovation Strategy Promotion Council. [STI]
- In each project implemented by the national government, the government will continue to actively introduce advanced technologies, encourage the use of advanced technologies in the real world, implement projects more efficiently and effectively, and promote social change. [STI, all ministries and agencies]

③ Promoting the resolution of social issues and the acquisition of international markets through the international and strategic use of intellectual property and standards

- In order to grasp the trends in the use of intellectual property and standards in foreign countries and to promote the strategic and international use of standards in Japan, the government as a whole will develop a control tower function and system, and strengthen and accelerate measures for the use of standards, including international standardization. From FY2021, the government will promote the strategic and international use of standards, including the appropriate use of forum standards, de facto standards, and de jure standards, through research and development projects, in important fields such as solving social issues and acquiring international markets. [SIPSH, STI, MIC, METI, relevant ministries and agencies]

[132] PRISM: Public/Private R&D Investment Strategic Expansion PrograM

- With regard to the strategic and international application of standards, from FY2020, the government will establish a public-private partnership system, promote public-private awareness reform, broad-based enhancement of activities in the industrial sector, and enhancement of human resources, and develop an environment that promotes changes in corporate behavior related to the application of standards through cooperation with government research and development projects, regulations, and systems. In addition, the government will establish a platform system that supports practical activities by private companies in cooperation with governmental organizations. [SIPSH, STI, MIC, METI, related ministries and agencies]
- The government will promote the development and platform of intellectual infrastructure, etc., which will be the source of Japan's high-quality manufacturing and services by FY2025, and broadly support socio-economic activities aimed at solving the people's lives and social issues. [METI]

④ Strategic promotion of science and technology diplomacy

- The government will promote the strategic development of science and technology diplomacy through the promotion of strategic bilateral and multilateral win-win cooperation and collaboration in important cutting-edge fields, the fundamental strengthening of support for international industry-academia joint research with a view to implementing the results in society, and the international development of the STI for SDGs activities. [STI, MOFA, MEXT]
- In light of the situation in which concerns such as conflicts of interest, conflicts of duty, and leakage of scientific and technological information are becoming more and more apparent as research activities become more international and open, the government will consider its response policy while paying attention to the difference between basic research and applied development, while also taking into account the importance of international joint research, and develop necessary guidelines such as guidelines for public invitation of competitive research funds and cooperation with foreign companies in 2021. In order to support independent assurance of the soundness and fairness (research integrity) of research that should be held by researchers, the government will establish the direction of its response in early 2021 in cooperation with research communities in Japan and overseas. These guidelines will be reviewed as necessary in light of the status of efforts by each research institute, research funding agency, etc. (Restated) [STI, MEXT, METI, relevant ministries and agencies]
- In order to play a leading role while Japan is actively involved in the formation of international agreements on science, technology, and innovation as well as the formation of frameworks and rules, the government will secure and expand the positions of Japanese staff and the chairmanship of international conferences of relevant international organizations, strategically develop candidates, and actively dispatch staff and experts from relevant ministries and agencies. [STI, MOFA, MEXT, METI, relevant ministries and agencies]

- Under the Japanese strategy for science and technology diplomacy, the government will strengthen the foundation that supports the strategic development of science and technology diplomacy by strengthening cooperation systems across ministries and agencies, strengthening information collection and dissemination systems centered on science and technology offices of diplomatic missions abroad and overseas offices of national research and development agencies, etc., and actively disseminating information on efforts toward the realization of Society 5.0 in international fora such as the G7. [STI, MOFA, MEXT, METI, related ministries and agencies]
- Through strategic promotion of international joint research through collaboration with overseas research fund allocation organizations, etc., formation of attractive research centers, international exchange of students and researchers, realization of world-class treatment and research environment, internationalization of universities, research institutes, research fund allocation organizations, etc., the government will build an international research network with Japan positioned at the core, and attract excellent human resources from around the world.

[Health, STI, MIC, MEXT, MHLW, MAFF, METI]

- Consider the method of tabulation of indicators such as the number of international cooperation agreements and international joint papers among the Top 1% papers in essential advanced fields by FY2021. [STI, relevant ministries and agencies]

2. Developing frontiers of knowledge and strengthening research capabilities as sources of value creation

Research based on the intrinsic motivation of researchers has pioneered the field of human knowledge, and its accumulation has supported human prosperity. The existence of diverse research activities and the accumulation of deep knowledge not only in natural sciences but also in humanities and social sciences have not only intellectual and cultural values in themselves, but also lead to the creation of creative new technologies and innovations that contribute to the resolution of social issues. In the research environment that fosters such knowledge, the development of human resources, the development of research infrastructure, as well as a culture that can take on the challenge of diverse research are essential. However, this cannot be realized overnight, and it is necessary to develop it as a fundamental function of the nation.

To this end, the first step is to improve the environment for students in doctoral programs[133], to enable young researchers to envision career paths that will enable them to play an active role not only in academia but also in a wide range of fields such as industry, thereby creating an environment in which excellent young people aspire to participate in doctoral programs. In addition, the first step is to promote basic research and academic research that produce diverse and outstanding knowledge, and to strengthen the promotion of innovative research that creates original results through knowledge exchanges with various entities while researchers concentrate on research. By doing so, the first step is to strengthen research capabilities and improve the research environment in Japan, creating a virtuous cycle in which the attractiveness of researchers further increases.

In addition, in order to create high-value-added and high-impact research in the digitalization of society as a whole, Japan will construct research systems based on new trends in research, such as the implementation of data-driven research including open science.

Furthermore, in order to realize such an environment, it is necessary to reform universities, which play a central role in basic research and academic research in Japan. In order to strengthen the functions and strategic management of universities, and to develop individual strengths, we will promote the growth of research universities[134] that are equal to those in the world. In particular, we will significantly accelerate these efforts by utilizing a university fund of around 10 trillion yen.

[Major goal]

- Continue to create knowledge with diversity and excellence, and restore the world's highest level of research capabilities

[Reference index]

- Number and percentage of participants in internationally notable research areas (Science map)
- Number of papers cited in patent
- Top 10% cited papers, percentage of total papers

[133] In this plan, “doctoral programs” include four-year doctoral programs and five-year doctoral programs (third to fifth years only).

[134] Universities in which researchers with the capacity to compete at the global top level gather, and Japanese and foreign researchers and students conduct cutting-edge research under them to create new interdisciplinary fields and make funds and human resources flow through co-creation with companies, while possessing an environment in which they can aim for the creation of innovation.

(1) Rebuilding the environment to produce diverse and outstanding research

1) Recognition of the current situation

In a society where there is high uncertainty due to unexpected events such as the spread of the novel coronavirus and the occurrence of catastrophic disasters resulting from climate change, issues that cannot be addressed through the extension of existing methods and mechanisms have emerged and are increasing in urgency. Under these circumstances, expectations for the role of researchers in creating deep knowledge as a weapon to confront unknown difficulties have increased more than ever. Basic research aimed at exploring the truth, clarifying basic principles, and discovering new ones, and the excellence and diversity of academic research based on the intrinsic motivation of individual researchers are the sources of value creation. As one of the fundamental functions of the nation, it is essential to develop a research environment for maintaining and strengthening these, and a framework for creating and utilizing the convergence of knowledge including humanities and social sciences.

However, Japan's research capabilities have declined in relative terms and in the long term compared to other countries in terms of the number of scientific papers. In addition, the ranking of the number of cited Top 10%-corrected scientific papers, which is related to the quality of scientific papers, has declined significantly. The ranking has also declined in all fields of research. In addition, the improvement of the environment in which young researchers and other researchers are placed has become a major issue. For example, the rate of advancement to the doctoral course has decreased, the employment of young researchers has been unstable, and the research time of researchers has decreased. The situation in which excellent students give up advancing to the doctoral course due to economic concerns, concerns about their career paths, educational and research environments that are at odds with their expectations is a symbol of the vague sense of stagnation currently prevailing in universities and research sites from the competitiveness of Japan has been weakened in the medium to long term. In addition, from the viewpoint of improving research diversity, the active participation of female researchers is expected, but the ratio of female researchers to all researchers is low. Also, from the number of internationally co-authored scientific papers, it can be seen that Japan's position has declined relative to other countries' research networks and is lagging behind the flow of the international brain circulation. This situation should be taken seriously, although it is not appropriate to judge research capabilities based solely on quantitative indicators such as scientific papers.

In order to overcome the current situation, concrete measures to improve started to improve the treatment of researchers based on the comprehensive package to strengthen research capacity and support young researchers formulated in January 2020. In view of the increasing expectations of this trend at research sites, it is urgent to steadily implement necessary measures, including the measures listed in this package.

[Current status data] (Reference index)

- Top 10% of citations ratio of corrected papers to total papers: 8.3% (2016-2018)[135]
- Total number of papers and international share: 81,095 papers, 5.3% (2016-2018 (3-year moving average))[136]
- Number and percentage of participants in research areas of international interest (Science map): 274 areas, 30% (2013-2018)[137]
- Number of doctorates conferred per population: 119 per million (2017)[138]

---

[135] Calculated by integer numbers. Ratio of cited Top 10% corrected scientific papers to all scientific papers from 2016 to 2018. Calculated based on the MEXT National Institute of Science and Technology Policy, Science and Technology Indicators 2020 (survey material 295, August 2020).
[136] Calculated by integer numbers. Calculated based on the MEXT National Institute of Science and Technology Policy, Science and Technology Indicators 2020 (survey material 295, August 2020).
[137] MEXT National Institute of Science and Technology Policy, Science Map 2018 (NISTEP REPORT-187, November 2020)
[138] MEXT National Institute of Science and Technology Policy, Science and Technology Indicators

- Number of young researchers (university regular teachers under 40) and their ratio to the total: 41,297, 22.2% (FY2019)[139]
- Ratio of female researchers to all researchers including private companies: 16.9% (FY2019)[140]
- Ratio of female researchers to university regular teachers: 25.9% (FY2020)[141]
- Percentage of women in doctoral course students (by field): science 20%; engineering 19%; agriculture 36%; medicine, dentistry, and pharmaceutical sciences 31%; humanities 53%; social sciences 37% (FY2020)[142]

2) Ideal form and direction for realizing it

In order to create diverse and outstanding research results that explore the frontiers of knowledge, we aim to create an environment in which researchers can fully demonstrate their abilities and continue to take on challenges to solve problems, based on their awareness of diverse problems inherent in each individual.

In order to achieve this, the government will first enhance the career path for excellent young people to advance to doctoral programs as the leaders of knowledge in a situation in which they can envision their future activities. Specifically, the government will rebuild a career system in which excellent young researchers can take pride in themselves as global leaders of knowledge in response to the needs of the times, find value worth staking their lives while securing sufficient time to devote themselves to research, and take on the challenge of becoming independent researchers. In the future, the government will develop an environment in which all desirable excellent doctoral researchers can gain regular positions in various fields such as academia, industry, and administration, and can envision their activities as leaders.

In order to achieve this, both academia and industry are required to make efforts. In other words, it is necessary for the industry to recognize that if there is an environment in which doctoral personnel with advanced problem-solving abilities, who set their own problems and solve them, can demonstrate their abilities, they will be able to play an active role in creating innovation in the industry and others. At the same time, academia needs to promote graduate school education reform, take responsibility for producing doctoral personnel suitable for supporting Society 5.0 in society, and be welcomed with confidence by society. At that time, the custom that doctoral students are regarded as inexpensive research workers will be reformed, and they will be appropriately treated as researchers and fostered as human resources who will lead the next generation of society. In addition, Japan will realize an environment in which the social reputation of the teachers in charge will be evaluated by the social performance of post-doctoral researchers. Under such an environment, excellent students and young people will choose the way of doctors to improve the depth and excellence of both academia and industry personnel.

In addition, in order to enhance the excellence of research, it is necessary to promote deep basic research and academic research as well as to actively exchange various forms of knowledge. The aim is to create an environment in which individual researchers can engage in research without being confined to their own specialized fields, engage in intellectual exchange with various entities, and be stimulated to produce highly outstanding and original research results.

To this end, we will aim to have many researchers accumulate training and experience under different research cultures and environments overseas, have them build up their careers as researchers, and build an international research network with overseas researchers. At the same time, an attractive research base will be formed to attract highly motivated and talented researchers from around the world. Top-level researchers will be recruited online as well. By promoting international joint research using these networks, an environment will be created in which new ideas can be created one after

---

2020 (survey material 295, August 2020).

[139] Calculated from the 2019 school teachers statistical survey (interim report)

[140] MIC, 2020 science and technology research survey results (December 2020)

[141] Calculated from the 2020 basic school survey, MEXT

[142]Calculated from the 2020 basic school survey, MEXT

another by stimulating each other.

Furthermore, in order to secure diversity in research and create gendered innovation[143], the government will further promote the active participation of female researchers, including those in leadership positions, and increase the number of potential knowledge bearers in Japan by breaking down the situation in which the percentage of women entering doctoral programs in natural sciences is low.

In addition, the government will strongly promote basic research and academic research, which are at the core of efforts to create knowledge, and in doing so, the government will promote competitive research cost reform to maximize the creation and utilization of knowledge, including providing seamless support for researchers.

The government will also comprehensively and systematically promote the humanities and social sciences, which aim to explore and present new values and the ideal way of society. It will also promote cooperation and collaboration with knowledge in natural sciences, and promote the creation of the convergence of knowledge that goes beyond the boundaries of the field. The entire academia in Japan will overcome the barriers of fields, face social issues, and continue to create more excellent knowledge globally through friendly competition.

[Target]

- In an environment where talented young people can expect to be active in various fields such as academia, industry, and administration, they take pride in themselves and go on to doctoral courses and take on the challenge, saying that they are worth staking their lives without having economic concerns.
- The creation and accumulation of diverse and outstanding research results from basic research and academic research will advance, and seamless support will be realized for researchers who can achieve this.
- In an environment in which diversity is ensured, time is secured for individual researchers to devote themselves to research, and active intellectual exchange with various subjects is promoted without being confined to their own specialized fields. Through opportunities for overseas training and overseas experience, stimulated research progresses in an emergently evolving manner, and research results with higher excellence are created.
- With the advancement of deep research in the humanities and social sciences, a variety of knowledge will be created. At the same time, it will become established to create and utilize the convergence of knowledge fused with the knowledge of natural sciences, with the aim of solving the increasingly complex problems faced by domestic, overseas, and local communities.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Students in doctoral programs who receive about the amount equivalent to living expenses: in order to improve the treatment of excellent students in doctoral programs, the number of students in doctoral programs receiving the amount equivalent to living expenses will be increased to three times the current number by FY2025[144] (equivalent to about 70% of

---

[143] Innovation created by incorporating gender perspectives into science and technology.

[144] According to MEXT's FY2019 promotion for university reforms project Survey Research Related to the Situation of Economic Support for Doctoral Students (March 2020), the FY2018 results was 10.1% of students in doctoral programs. The realization of the above numerical target is equivalent to about 30% of all doctoral students receiving the amount equivalent to living expenses. In this plan, the amount equivalent to living expenses received by doctoral students is considered to be 1.8 million yen per year or more. However, we will greatly expand the number of beneficiaries receiving about 2.4 million yen per year, the level received from the Research Fellowship for Young

students moving up from master's programs). Additionally, all excellent students in doctoral programs who wish to receive the amount equivalent to living expenses will receive it in the future.

- Number of science and engineering doctorates hired by the industrial sector: the number of persons hired per year increases by approximately 1,000 by FY2025 (1,151[145] out of 4,570 science and engineering Doctorates in 2018).
- Number of university teachers under 40: From the viewpoint of strengthening research capabilities in Japan, the number of university teachers under 40 will be increased by 10% during the basic plan period[146], and the percentage of university teachers under 40 will be increased to 30% or more in the future.
- Tenure-and tenure-track teachers as a percentage of university full-time teachers aged 35-39 at research universities (national universities in ③ whose core functions are educational research and social implementation that are outstanding in the world as a whole, in line with foreign universities that produce outstanding results)[147]: increase by 10% or more from the percentage in 2019 during the Basic Plan period[148]
- Percentage of new female researchers employed by universities: 20% in science, 15% in engineering, 30% in agriculture, 30% in medicine, dentistry, and pharmaceutical sciences combined, 45% for humanities, and 30% for social sciences by FY2025
- The percentage of women among university professors (presidents, vice presidents, and

---

Students (DC) of the Japan Society for the Promotion of Science, through the use of investment profits for university funds, efforts to strengthen support to doctoral students, as well as expenditures for research assistants (RA) from competitive research funds, etc. to raise Japan's doctoral programs to a global level. From the perspective of attracting excellent students from overseas, we will review the amount equivalent to living expenses and consider a system to make a world-level treatment possible.

[145] Calculated based on the FY2019 project commissioned by MEXT, "Survey and Study on Understanding and Analysis of Educational Reform in Graduate Schools" (March 2020, Libertas Consulting Co., Ltd.)

[146] According to MEXT's 2019 School Teacher Statistics Survey (Interim Report), the number of university full-time teachers under 40 in FY2019 was 41,297, and the percentage of university full-time teachers under 40 was 22.2%.

[147] It is necessary to pay attention to the fact that the situation and the proportion of researchers at each university and each field are different, and it is important for each university to aim at achieving the goal based on the situation. In particular, in the health field, medical graduate schools in the medical and dental fields are attended by medical graduate students, etc., and the age of completion tends to be higher. In addition, medical teachers such as doctors and dentists belonging to attached hospitals, etc. are included, and the mobility of such teachers is high, for example, they are transferred within hospitals to university departments and hospitals and dispatched to hospitals and clinics that cooperate with them in medical care services and hospital management, etc. Therefore, it is necessary to consider the fact that in many cases they are operated with a "fixed term."
In addition, it is important to consider that some researchers have a period of suspension due to childbirth, childcare, etc., and to aim to achieve the goal.

[148] According to a survey by MEXT, the ratio of tenure and tenure-track teachers among university full-time teachers aged 35-39 at national universities in ③ in FY2019 was 44.8%, equivalent to 49.3% overall.

professors) [149]will be 20% at an early stage and 23% by FY2025 (17.7% as of FY2020).[150]

- Ratio of on-campus clerical work to the duties of university teachers: halved by FY2025 (18% by FY2017)[151]

3) Concrete measures

a. Improving treatment of doctoral students and expanding career paths

- With regard to improving the treatment of doctoral students and expanding their career paths, the government will continue to analyze and follow up on students who require various forms of support, and will make concerted efforts by mobilizing all of various policy resources with the cooperation of the industrial sector. The government will also continue to provide support through the enhancement of the Research Fellowship Program (DC), the Japan Student Services Organization Scholarship (those who have achieved outstanding academic performance are exempt from returning the money) and tuition reduction for graduate students at universities, utilization of the investment profits from university funds, and efforts to strengthen support for doctoral students ahead of this. In addition, in order to promote the payment of salaries to doctoral students at an appropriate level as a research assistant (RA) from competitive research funds and joint research funds, the government will formulate rules for the payment of RA expenses relating to employment and remuneration for RAs at each business and university, and implement them sequentially from FY2021. [STI, MEXT, relevant ministries and agencies]
- In FY2021, the government will start a program to establish university fellowships, which will provide integrated support to excellent doctoral students, who are strategically secured by universities, from their lives as students to the acquisition of posts after graduation, and will promote economic support through organizations to which they belong. [MEXT]
- In addition to ensuring transparency and fairness in the examination of doctorate degrees, measures to ensure that the results of posts and social activities of doctoral students after completion are also used as the evaluation of universities and teachers in charge will be examined at the university support forum PEAKS[152] and other forums. We will encourage a fundamental change in awareness that it is the duty of the advisor to train doctoral students as next-generation researchers, and that this will be reflected in their own evaluation.[STI, MEXT]
- In FY2021, the government will implement long-term paid internships at graduate schools in cooperation with industry and universities to develop practical skills backed up by research capabilities in doctoral programs. The government will also promote participation in industry-university cooperation activities, and increase opportunities for students in doctoral programs to explore the possibility of diverse participation in the industry. In addition, the government will expand career paths for doctoral students in the industry by establishing a system for discovering (matching) excellent young researchers by companies and universities and promoting the employment of doctoral graduates in companies. [MEXT, METI]
- With regard to the employment, duties, and treatment of doctoral graduates among national public officers and industries both in Japan and overseas, the government will investigate the actual conditions and needs of such graduates and develop good examples of such graduates from FY2021, and at the same time, advance the consideration of improving the treatment of doctoral

---

[149] With regard to setting targets by field and position, it is necessary for each university and graduate school to strategically set, disclose, and verify targets in accordance with the characteristics of the field and institution.

[150] Calculated from MEXT, FY2020 School Basic Survey

[151]MEXT, "Survey on Full Time Conversion Data at Universities, etc."

[152] A forum established in FY2019 by university officials, industry, and the government to discuss management issues and solutions at universities, horizontally develop good practices that lead to innovation, consider deregulation, and develop university management.

graduates among national public officers based on their professional knowledge and research experience and come to a conclusion at an early stage. [CBPA, NPA,STI, MEXT, METI, all ministries and agencies]

b. Development of an environment in which young researchers can play active roles in universities

- The government will advance the provision of posts to young researchers using external funds and the utilization of a tenure track system and clarifying standards. Additionally, to promote efforts to secure posts for young researchers throughout the organization, encourage the development and active participation of young researchers, and build a sustainable research system through measures such as promoting the utilization of an annual salary system and cross-appointment system for senior researchers, and promoting the conversion to fixed-term employment using external funds. To this end, in FY2021, the government will prepare a supplementary edition of the Guidelines for Reform of Personnel Management and Remuneration Management, which includes excellent examples of such efforts. In addition, the government will promote efforts to reallocate the number of students (transfer of the number of students, reorganization of the educational research organization) so that universities will actively implement reforms to allow more students to advance to doctoral programs in academic fields that they believe should be intensively enhanced based on their own strategies. [MEXT]
- From FY2021, the government will pay personnel expenses for researchers at universities and national research and development agencies from competitive research expenses and corporate joint research expenses, and will promote the creation of stable posts for young researchers through organizational management from the financial resources thus secured. In addition, the government will promote a scheme to raise the salary level by acquiring external funds (mixed salary) from FY2021 in order to achieve world-class treatment for excellent researchers. [STI, MEXT, relevant ministries and agencies]
- In order to build a team-type research system in which management personnel from URA[153], etc., and highly skilled professional personnel such as engineers (including technical personnel who support research in all fields at universities, etc.), etc., work together to ensure the quality of their professional duties and improve their treatment will be implemented by the end of FY2021 so that they will become attractive positions. This will enable the enhancement of mobility and career paths of professional personnel, including doctoral personnel, as well as the development and securing of them. [MEXT]
- Follow-up surveys on the employment status and treatment of doctoral graduates will be conducted periodically during the Basic Plan period. Each university will also continue to monitor the employment and activity status of doctoral graduates even after completion, and publish details of employment status on the Internet, etc. [STI, MEXT]

c. Promotion of active participation of female researchers

- The government will improve the environment and support systems for both male and female researchers to balance childcare and nursing care with research, including the establishment of on-campus childcare facilities, the promotion of work style reforms, the additional employment of post-doctoral researchers when there are researchers on maternity leave, and the establishment of items related to diversity in the performance evaluation of managers. As part of these efforts, the government will clearly state in FY2021 that the period of maternity leave and childcare leave will be taken into consideration in the age restrictions, etc. of guidelines for public recruitment of support projects for young researchers.[154] Additionally, the government will promote consideration for researchers taking maternity leave and childcare leave such as by taking similar

[153] URA: University Research Administrator.

[154] For example, in the Fusion Oriented Research project, the application requirements will be within 15 years after obtaining a doctoral degree in principle, and within 20 years after obtaining a doctoral degree for those who could not devote themselves to research due to childbirth and childcare.

measures for age restriction for the recruitment of young teachers at universities, etc. [CCRA, MEXT, MHLW, METI, relevant ministries and agencies]

- Universities and public research institutes will utilize the Act on Promotion of Women's Participation and Advancement in the Workplace to set and publish strategic numerical targets for the percentage of women employed and the percentage of women promoted to leadership positions, etc. by each business operator in accordance with the characteristics of the organization and the percentage of women enrolled in doctoral programs in each field (science 20%; engineering 19%; agricultural 36%; medical, dental, and pharmaceutical 31%; humanities 53%; social science 37% (FY2020)[155]). [Gender Equality, MEXT, relevant ministries and agencies]
- Efforts by national universities to build teacher organizations with diverse human resources, such as female researchers, and efforts to encourage female students to advance to science and engineering departments will be evaluated as management achievements of university presidents and reflected in the allocation of operating expense subsidies. In addition, efforts by private universities, etc. to support female researchers and researchers of the child-raising generation will be supported by the current expense subsidy for private universities, etc. in order to support efforts by private universities, etc. to support female researchers, such as building flexible working systems. [MEXT]
- In order to communicate the appeal of science and engineering to junior high and high school students, parents, and teachers, and in order to increase the proportion of women in master's programs and doctoral programs, mainly in science and engineering, the government will promote the presentation of career paths and role models for female researchers. In order to promote the advancement of women in science and engineering, the government will further enhance the career paths and role models of female researchers from FY2021. [Gender Equality, MEXT]

d. Promotion of basic and academic research

- In order to create and expand a variety of knowledge through academic research, the government will secure and enhance financial resources that can be used at the discretion of the organization, including basic costs. At the same time, the government will secure and enhance grants-in-aid for scientific research (scientific research funds) that support creative and challenging research subjects in accordance with the careers of researchers, aiming at a new adoption rate of 30%, while continuously promoting system improvements such as support for young researchers, further promotion of emerging and fusion research and internationalization, and review of examination categories. [MEXT]
- With regard to the Strategic Basic Research Programs[156], from FY2021, the government will promote priority support for young researchers and seamless support for excellent researchers. At the same time, the government will promote basic research for the post-coronavirus era by bringing together and merging researchers from a wide range of fields, including the humanities and social sciences. The government will also enhance and improve the program in order to take on emerging and fusion fields, promote overseas challenges, and strengthen international joint research. [MEXT]
- By providing researchers around the time they become independent, mainly young researchers, with an environment in which they can boldly concentrate on their own ambitious ideas over the long term, the government will steadily promote Fusion Oriented Research for Disruptive Science and Technology projects[157] with the aim of creating results that can lead to disruptive innovation,

---

[155] Calculated from the 2020 basic school survey, MEXT

[156] A project to strategically promote basic research as a source of innovation by establishing a temporary research system (network-type research institute) that transcends organizational and sectoral boundaries under strategic objectives set by the national government.

[157] This project provides long-term support for free, challenging, and interdisciplinary research that is not bound by existing frameworks while ensuring a research environment in which researchers can concentrate on research.

breaking away from short-term performance-based approaches, and will also enhance projects with a view to steady implementation. [MEXT]

- In the evaluation of large-scale projects and competitive research expenditures, the government will more actively evaluate the generation of results and spin-outs that were not initially expected, and that research has continued to be challenged, and will also introduce a system in which young researchers participate in the examination to the extent that it does not impose an excessive burden, from the viewpoint of taking diverse viewpoints into consideration. [MEXT]
- The government will promote the development and utilization of large-scale projects and advanced large-scale facilities and equipment leading the world's academic frontier. [MEXT]
- With regard to joint use and joint research centers that effectively and efficiently promote joint use and joint research by making the most of the research potential of universities, national universities will promote activities that contribute to the fusion of different fields, creation of new fields, and resolution of social issues through flexible organization in response to academic development and research diversification during the fourth medium-term target period starting in FY2022, based on the system revision to promote networking.[158] [MEXT]
- With regard to inter-university research institute corporations[159], which provide researchers nationwide with large-scale facilities and equipment, data, and valuable materials that are difficult to operate at individual universities, etc., and which support education and research at universities in Japan, the government will strengthen their functions by reflecting them in the establishment of the mid-term objectives and the organizational review toward the fourth mid-term objectives period starting in FY2022, based on the results of the verification of education and research activities at each inter-university research institute.[160] [MEXT]
- In order to analyze and evaluate Japan's research capabilities from multiple perspectives, researchmap[161], etc. will be utilized to efficiently gain and analyze diverse information related to researchers. Furthermore, taking into account overseas trends, new indicators such as innovation creation, development of new fields, and contribution to diversity will be developed in 2022 in addition to the existing number of papers and citation index, and their sophistication and continuous monitoring will be carried out. [STI, MEXT, METI]

e. Promotion of international joint research and international brain circulation

- Conduct international joint research with developed countries with high levels of science and technology such as the United States and countries in the European Union, and promote science and technology cooperation with emerging and developing countries such as India and Kenya around the SDGs. Contribute to the development of science and technology, human resource development, and the resolution of global issues, including medium- and long-term perspectives. [STI, MEXT, relevant ministries and agencies]

---

[158] On December 23, 2020, the MEXT Notification No. 133 (July 31, 2008) partially revised the "Regulations on Joint Use, Joint Research Sites, and Accreditation of International Joint Use, Joint Research Sites, etc."

[159] Four corporations: National Institutes for the Humanities, National Institutes of Natural Sciences, High Energy Accelerator Research Organization, and Research Organization of Information and Systems

[160] The Council for Science and Technology conducts external verification of the results of self-verification by each institution to determine whether the educational and research activities of each inter-university research institute respond to trends in academic research and contribute to the development of academic research at universities.

[161] A comprehensive database of Japanese researchers operated by the Japan Society for the Promotion of Science. Researchers register information on their own background, research results, etc. to disseminate information on researchers and encourage communication, as well as contribute to the unified management of research information and reduction of administrative burden. The National Institute of Informatics conducts research and development on the system.

- With a view to expanding opportunities for overseas research institutes and overseas experience for Japanese students and young researchers, inviting excellent researchers from foreign countries, and promoting the employment of foreign researchers, by FY2021, the government will formulate a strategy for the international development of science and technology, including support measures and environmental improvement (internationalization of methods for international public recruitment and employment of post-doctorates, measures for salaries and treatment at the international level, living support including family members, improvement of international administrative systems, formation of international research centers, etc.), and will work on measures in order to promote the employment of foreign researchers. The government will also consider numerical targets by FY2022 based on an understanding of the actual status of international brain circulation and an analysis of issues. [STI, MEXT]
- Through strategic promotion of international joint research through collaboration with overseas research fund allocation organizations, etc., formation of attractive research centers, international exchange of students and researchers, realization of world-class treatment and research environment, internationalization of universities, research institutes, research fund allocation organizations, etc., the government will build an international research network with Japan positioned at the core, and attract excellent human resources from around the world. (Restated) [Health, STI, MIC, MEXT, MHLW, MAFF, METI]

f. Securing research time

- In order to build a team-type research system in which management personnel from URA, etc., and highly skilled professional personnel such as engineers (including technical personnel who support research in all fields at universities, etc.), etc., are united, efforts will be made by the end of FY2021 to improve the security of professional quality and treatment so that these will become attractive positions. Through this, the mobility and career paths of professional personnel, including doctoral personnel, will be enhanced, and at the same time, they will be fostered and secured. (Restated) [MEXT]
- From FY2021, the government will promote the adoption of smart laboratories at universities, the diffusion of services provided by private businesses that will contribute to securing research time, the lateral development of good practices for improving the efficiency of university management operations, the simplification of administrative processes at national universities, and digitalization. [MEXT]
- With regard to competitive research expenses, the government will unify, simplify, digitalize and speed up the rules pertaining to various administrative procedures, based on the opinions of the field, and implement them from FY2021. [STI, MEXT, related ministries and agencies]

g. Promotion of the humanities and social sciences and creation of the convergence of knowledge

- The government will strengthen and enhance joint use and joint research systems beyond the boundaries of universities that support academic research in the fields of the humanities and social sciences, and will accumulate multilayered and multifaceted knowledge by promoting research in the humanities and social sciences based on intrinsic motives through scientific research funding, etc. [MEXT]
- With regard to the various issues that will be faced by the future society, by the end of FY2021, the government will establish and promote a research support system in which researchers in the humanities and social sciences take the lead in tackling research issues, and will also consider measures to promote the active participation of young researchers. [MEXT]
- With regard to the data platform for promoting the sharing and utilization of research data in the humanities and social sciences in Japan, by FY2022, the government will develop the infrastructure such as a system that can search for research data in the humanities and social sciences in Japan in a unified manner. In addition, the government will determine the direction from FY2023 based on the progress made in these areas, and will further strengthen the data platform in the humanities and social sciences based on this policy. Furthermore, the government

will determine the direction by FY2022 in order to strengthen support functions such as the management and utilization of research data through digital conversion of libraries. [MEXT]

- In order to promote the creation and utilization of the convergence of knowledge, from FY2021, the government will actively consider setting targets focusing on the utilization of the convergence of knowledge including the fields of humanities and social sciences, and will promote research in publicly offered strategic research projects. In order to actively promote the creation of the convergence of knowledge, the government will also include the creation of the convergence of knowledge through the fusion of high-level fields at the world's most advanced international research centers in its initiative. [STI, MEXT]
- Based on the policy issues of the relevant ministries and agencies, from FY2021, the government will further strengthen efforts by researchers in the field of the humanities and social sciences to cooperate with administrative officials to conduct policy research and analysis. In addition, with a view to the future society, the government will support efforts by researchers in the fields of the humanities and social sciences and various stakeholders in society to jointly create issues that should be addressed through the convergence of knowledge. Through such efforts, the government will strengthen human networks for solving social problems. [MEXT]
- By the end of FY2021, the government will draw up basic concepts and strategic measures to promote the convergence of knowledge, which contributes to a comprehensive understanding of human beings and society and to solving problems through the fusion of knowledge in the humanities and social sciences and knowledge in the natural sciences. In addition, by the end of FY2022, the government will examine indicators related to the humanities and social sciences and the convergence of knowledge, and will monitor them from FY2023. [STI, MEXT]
- Based on the above-mentioned measures concerning the convergence of knowledge, while developing career paths in line with the needs of society, the government will consider measures to promote human resource development in the humanities and social sciences through graduate school education reform, and will determine the direction of such measures by FY2022. [STI, MEXT]

h. Integrated reform of the competitive research funding system

- From FY2021, the government will accelerate efforts to strengthen cooperation among institutions for allocating research funds, such as increasing communication through sharing project evaluation results, establishing opportunities for people-to-people exchanges and information sharing, and establishing mechanisms for recommending researchers and research results. [STI, MEXT, METI, relevant ministries and agencies]
- With regard to competitive research expenses, the government will unify, simplify, digitalize and speed up the rules pertaining to various administrative procedures based on the opinions of the field, and implement them from FY2021. (Restated) [STI, MEXT, relevant ministries and agencies]
- With regard to the treatment of indirect expenses in competitive research expenses, unification of rules including the ratio to direct expenses, etc., and simplification of use reports and documentary evidence shall be examined, and implement them from FY2022. [STI, MEXT, relevant ministries and agencies]
- From FY2021, the government will accelerate efforts to provide seamless support for research aimed at strengthening basic research capabilities, based on specific implementation plans. With regard to scientific research grants and strategic research promotion projects, the government will enhance support for young researchers, strengthen efforts to ensure that talented mid-and high-ranking researchers can secure research funding in a stable and sufficient manner (such as reviewing allocations and examinations), and promote new and integrated research. With regard to projects that link the results of basic research to industry, the government will strengthen systems for evaluating academic values and flexible support systems in accordance with research phases, including support for matching with industry. [MEXT]
- In addition to visualization and analysis of R&D results using e-CSTI, the government will attempt to set priority areas during FY2021, such as establishing a new policy cycle of

identifying and conducting research on the following priority areas for the resolution of social issues. Additionally, in order to make consideration based on changes in global trends in research and development as well, the policy cycle will be established as a mechanism in which regular follow-up is possible. [STI, MEXT, relevant ministries and agencies]

(2) Construction of new research systems (promotion of open science and data-driven research, etc.)

1) Recognition of the current situation

While it has become easier to collect and analyze various data such as big data, the impact of computer-based simulations and AI-based research has become even greater. In addition, the novel coronavirus has accelerated the flow of research activities DX (research DX) around the world, such as the remoteness of research exchanges, the remote connection to research facilities and equipment, and the expansion of data-driven research.

As a result, the use of open access to research papers and the use of preprints as a place for quick disclosure of research results are accelerating. Research results are being opened to the public with the aim of sharing knowledge around the world, such as open science, including the disclosure and sharing of research results. On the other hand, there are cases in which research papers using unreliable research data are withdrawn, and there are also movements in which world-class publishing companies and IT companies embrace research results and data obtained through research processes as business objects. In light of this situation, governments, international organizations, industries, academia, etc. are required to implement research process management based on an open and closed strategy, while respecting freedom and diversity in research activities interests of each subject.

In Japan, research infrastructures such as networks, institutional repositories, data platforms, and computing resources, as well as institutional environments such as various guidelines have been developed.

In particular, with regard to the management and utilization of research data obtained through public funds, most universities have developed institutional repositories, but on the other hand, there are problems such as the fact that the collection of research data has not progressed and that fact that data policies have not been developed. Some pioneering programs have been working to aggregate, search, and browse metadata for research data in order to promote wide-ranging use of research data, but efforts to manage and utilize research data are only halfway through. There are also legal and institutional issues related to research data, such as the attribution of research data and the handling of personal information.

Japan's digital research infrastructure is contributing to high-quality research and education through the development of infrastructure such as Fugaku, which ranked first in the world in the four supercomputer rankings in 2020, and the Scientific Information Network (SINET). On the other hand, many of the shared facilities and equipment at universities and public research institutes were using old systems, making it difficult to connect them to external networks during the coronavirus pandemic. The problem of remote use of such systems has become apparent. In addition, although research DX involves the transformation and development of research activities, the maintenance and use of research facilities and equipment still remains an entrenched and independent culture, and improvement is required.

[Current status data] (Reference index)

- Number of national research and development agencies with research data policies: 11 (September 2020)
- Number of ministries, agencies, and organizations that have adopted the Data Management Plan (DMP) under the Competitive Research Funding System: 8 ministries, agencies, and organizations (September 2020)
- Number of institutional repositories established in Japan: 811 (FY2019)
- Researchers with experience in disclosing research data: 51.9% (FY2018)
- Percentage of researchers with experience in releasing preprints: 20.4% (FY2020)
- HPCI capacity: 25 petaflops per year (FY2019)
- Share of joint research facilities and equipment: of 10 research equipment with a considerable market size purchased by universities, etc., (purchased in FY2012-2016) , 90% of those purchased with competitive funds were used by individual researchers and laboratories.

(FY2017)

2) Ideal form and direction for realizing it

The aim is to create high value-added research results and to demonstrate Japan's presence through digitalization of society as a whole and the DX of research itself, which captures the global trend of open science. In particular, research on novel coronavirus is expected to further expand the use of open access and scientific papers preprints. In this context, it is necessary to appropriately share and utilize data generated in the overall research process in a strategic manner, and to realize a research foundation for generating high-impact research results.

To this end, with regard to data sharing and utilization of data, the government will first develop an environment for promoting the management and utilization of research data based on an open and closed strategy while respecting freedom of research and diversity under a platform that enables high-quality research data to be obtained at research sites and enables cross-sectional retrieval of such research data. In particular, a mechanism that ensures data reliability will be essential. Based on this, the government will also promote the implementation of cutting-edge data-driven research and AI-driven research, as well as the research of information science and technology that supports these new research methods.

At the same time, the government will establish and maintain the world's most advanced research infrastructure for networks, data infrastructure, and computing resources, and will promote its wide-ranging use and application regardless of industry or academia. It will also promote the spread of smart labs, which enable shared facilities and equipment of large research facilities, universities, and national research and development agencies to be used remotely for research, as well as the automation of experiments. This will enable research to be carried out beyond the constraints of time and distance, and is expected to significantly reduce the burden on researchers. It will also enable the use of research facilities and equipment, etc. that are open to all researchers, including the development of data utilization systems, for such research infrastructure, and create an environment in which researchers can devote themselves more freely to cutting-edge research.

The appropriate management and utilization of high-quality research data, the active utilization of data science including AI, and the development of an advanced infrastructure environment will not only improve the efficiency of the research process, but will also dramatically expand the scope of research exploration, discover and present new hypotheses, and change the process that goes into the intellectual activities of researchers themselves. This will replace some of the activities that previously depended on individual intuition and experience. This will lead to the creation of high-impact research results using data, and will allow researchers to apply their valuable time to higher value-added intellectual activities such as the formulation of research visions and hypotheses. At the same time, it will contribute to the development of open science from a global perspective.

In addition, changes in research activities and employment practices in Japan as a whole may change the way researchers work. In Japan, an environment will be created in which various entities can participate in research activities and play active roles, such as citizen participation in research as citizen science and the freelance of researchers, which are already seen in various parts of the world. Researchers and non-researchers will promote sharing and integration of knowledge while fostering trust, and create new forms of value.

[Target]

- The management and utilization of research data based on the open and closed strategy, the development of the world's most advanced network and computing resources, and the sharing and smartization of facilities and equipment will enable researchers to effectively access necessary knowledge and research resources. High value-added research such as data-driven research will be accelerated, and research activities will be conducted with the participation of various entities such as citizens.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

・ By 2025, 100% of all universities, inter-university research institute corporations, and national research and development agencies with institutional repositories will establish data policies. By FY2023, 100% of all publicly offered research funds[162] will introduce data management plans (DMPs) and related metadata provision mechanisms.

Concrete measures

a. Development of an environment for promoting appropriate management and utilization of reliable research data

- The government will continue to disseminate and publicize the Research Data Cloud (NII Research Data Cloud), which started full-blown operation in FY2020 as a core platform for the management and utilization of research data in Japan, and to make necessary improvements. In addition, in order to make wide-ranging use of research data obtained through public funds by industry, academia, and government, the government will promote the provision of systematic metadata[163] by FY2023, and will establish a system that can search for such metadata on the research data infrastructure system from FY2008. In addition, in order to make use of metadata for EBPM[164], the government will ensure interoperability with the modification of e-Rad. Measures for securing a sustainable management system for research data infrastructure systems will be examined by FY2022. [STI, MEXT, relevant ministries and agencies]
- In order to manage and utilize research data obtained with public funds in institutions, research and development institutions such as universities, inter-university research institute corporations, and national research and development agencies will formulate data policies and promote the inclusion of research data in the institution repository. In addition, in order to make research data searchable on the research data infrastructure system, metadata will be added to research data. [STI, MEXT, relevant ministries and agencies]
- A data management plan (DMP) and a mechanism for providing metadata linked to the DMP will be introduced by FY2023 in order to manage and utilize research data for all new subscriptions of publicly offered research funds. Similarly, in the next SIP, DMP will be formulated and metadata will be provided. [STI, MEXT, relevant ministries and agencies]
- By the end of FY2023, the government will establish a system to mutually utilize data between the Research and Data Infrastructure System and the data collaboration infrastructure in each field to be established by the research and development themes (SIP, etc.) implemented by the Cabinet Office. [STI, MEXT]
- In order to promote the management and utilization of research data by researchers, the direction of initiatives such as data curators, library staff, URA, senior human resources who have retired from the front line of research, human resources who have engaged in research-related work at companies, etc., participation of post-docs when contributing to their own research activities, and digital conversion of libraries will be determined by FY2022. [STI, MEXT, relevant ministries and agencies]
- The government will respect free and open research activities and promote collaboration on the management and utilization of research data with countries, regions, international organizations, etc. (EU, G7, OECD, etc.) that share values with Japan. The government will

---

[162] Regarding the Public research funds specified as the subject of the system in the Cross-Ministerial Research and Development Management System Common R&D Management System for the Cabinet Office and Ministries (e-Rad)" (Public research funds specified as the subject of the system in (https://www.e-rad.go.jp/dl_file/particulars_e-rad.pdf).

[163] Systematic metadata refers to date that presents an overview of research data through a unified format and includes information such as the name and explanation of research data, the administrator, storage place, and whether the data is shared or released. Integrated Innovation Strategy 2020 (decided by the Cabinet on July 17, 2020) establishes the data policy at the national level.

[164] EBPM: Evidence-based Policy Making

aim to build a global platform during the period of this plan by promoting international collaboration between Japan's research data infrastructure systems and comparable initiatives and by enhancing international interoperability on the management and utilization of research data. [STI, MEXT]

- From the perspective of further promoting efforts related to the management and utilization of research data, by 2022, the status of these efforts will be introduced into the evaluation system of researchers, programs, institutions, etc. [STI, relevant ministries and agencies]

b. Development of infrastructure to support research DX and acceleration of high value-added research

- In FY2022, the government will strengthen the ultra-high speed and large capacity network that connects the entire country (SINET) as an academic information infrastructure for universities and research institutes in Japan. By operating SINET in an integrated manner with the Research and Data Infrastructure System, the government will continue to promote research and development of technologies that support the academic information infrastructure. By FY2021, the government will also consider measures to develop an environment that can be used not only as an academic information infrastructure but also in cooperation with the private sector as a social infrastructure for universities and research institutes. [STI, MEXT]
- With regard to supercomputing resources from 2021, the government will advance full-scale use of the supercomputer Fugaku and will strengthen the supercomputing resources of domestic universities and national research and development agencies as a stable computing base to meet the diverse needs of researchers nationwide. In addition, with regard to next-generation computing resources, the government will examine them through industry, academia, and government cooperation, taking into account the technologies in which Japan possesses strength, and determine the direction of such next-generation computing resources by FY2021. Based on the results of such examination, the government will implement necessary measures. [MEXT, relevant ministries and agencies]
- With regard to research facilities and equipment, the national government will formulate guidelines for the common use of research facilities and equipment by FY2021. Research facilities and equipment that are versatile and of a certain size or larger will, in principle, be shared. In addition, from FY2022, universities and public research institutes will formulate and publicize policies for the internal and external sharing of research facilities and equipment. In addition, when applying for research funds, research institutes will closely examine whether inefficient research facilities and equipment have been installed from the viewpoint of optimal management of the entire organization. Through these efforts, a framework for the introduction, renewal, and utilization of organizational research facilities (core facilities) will be established. With regard to major research facilities and equipment already installed in Japan, cooperation between facilities and equipment will be promoted. By the end of FY2021, a framework for one-stop response to needs and inquiries from various parts of the country will be started and completed by FY2025. In addition, the government will promote the steady development and utilization of next-generation synchrotron radiation facilities, which are currently being constructed through a public-private framework, and will systematically develop shared facilities and equipment including large-scale research facilities, universities, and national research and development agencies, including remote and smart facilities. [STI, MEXT, relevant ministries and agencies]
- In order to advance data-driven research, by FY2023, the government will develop a platform for the creation and sharing of high-quality data in the field of materials, and conduct trial operations. Similarly, in the field of life sciences, the government will promote the strategic and systematic development of information infrastructure, including genome data, which is the basis of data-driven research, and biological genetic resources. In addition, the government will also develop an environment for the promotion of data-driven research in the fields of environment, energy, oceans, and disaster prevention. Additionally, the government will advance the development of an environment in which information related to research outcomes such as literature including preprints can be widely used, as well as accelerate research on

mathematics and information science and technology, including the basic fields (OS, programming, security, databases, etc.) that support such research. [MEXT, METI]

- New analytical methods and indicators for changes in research activities through DX will be developed on the basis of the experimental measures implemented in FY2020, and their upgrading and monitoring will be implemented from FY2021. [MEXT]

c. Cultivating new research communities and environments pioneered by research DX

- The government will promote research activities such as the creation and fusion of knowledge by co-creating with various entities such as local governments, NPOs and NGOs, small and medium-sized enterprises and start-ups, freelance researchers, and citizen participation. In addition, the government will implement the development of an environment that encourages the participation of various entities as a new science, technology, and innovation policy formulation process as a bottom-up approach by industry, academia, and government, such as the launch of citizen science research projects that expect the participation of many citizens by collecting many samples and conducting scientific experiments that cannot be realized by researchers alone (on a scale of 10,000 people, with the assumption that it will start by FY2022). [STI, MEXT]

(3) Promoting university reform and expanding functions for strategic management

1) Recognition of the current situation

Universities are the nodes of diverse knowledge, and also the largest and most advanced foundation for knowledge. They have tangible and intangible intellectual assets such as research personnel, research facilities and equipment, various databases and their analytical functions, functions as hubs of industry-academia collaboration, and international networks of knowledge. As academic centers, they are required to play a leading role in the Society 5.0 era by making maximum use of this potential in various forms. In particular, national universities play an extremely important role in various aspects, such as the promotion of research in cutting-edge and fusion fields, the creation of sources of innovation, the establishment of the convergence of knowledge combining natural sciences with humanities and social sciences, and the creation of knowledge, human resource development, and employment creation required for local communities.

While universities have been returning the results of various educational research to society, they have often been evaluated by society and selected by students and researchers based on limited criteria such as university name and deviation value. As a result of being bound by such specific values, the individuality of each university and the mission to be achieved are not always clear, and the depth of the university demographic is not fully utilized in creating value in our country.

Looking abroad, major Asian universities are increasing their presence in terms of research and budgets, and Japan is losing its presence not only among the top universities in Europe and the United States, but also among Asian universities. In fact, Japan has the second most colleges and universities ranking in *Times Higher Education* magazine's global university ranking after the United States, but while Japan has a broad base of universities, the number of Japanese universities in the top 50 Asian universities rankings has halved from 11 in 2013 to five in 2020.

In particular, national universities in Japan have been incorporated since 2004, and environment has been developed so that the top of the organization can carry out management. However, due to management by the national government, the small managerial discretion of universities, and the side-by-side customs within universities, the realization of attractive national universities with vitality and individuality in a competitive environment," which had been envisioned at the time of incorporation, is only half way off.

On the other hand, in the Comprehensive Economic Measures to Secure People's Lives and Livelihoods towards Relief and Hope decided by the Cabinet in December 2020, the establishment of a 10 trillion yen university fund was incorporated, and it is expected to be a major trigger for university reform in Japan as a bold policy with a high impact.

In addition, national research and development agencies have a wide range of responsibilities under a long-term vision, including basic and fundamental research that is difficult for the private sector, demonstration tests, development of elemental technologies that contribute to the formulation of technical standards, and allocation of funds for R&D to other organizations based on national or international demands. These responsibilities need to be met with certainty, and the financial base needs to be strengthened, including improvement of systems and diversification of financial resources.

[Current status data] (Reference index)

- Annual average rate of increase in donation income of national university corporations from FY2007 to FY2018: 1.3%
- Amount of joint research received from private enterprises by universities and national research and development agencies: 88.2 billion yen (FY2018)
- Growth rates of ordinary expenditure in FY2005-2019 at major universities (excluding hospital expenses): Tokyo University (1.7%), Kyoto University (2.0%), Osaka University (1.7%), Tohoku University (1.1%); Reference: Stanford University (6.4%)

2) Ideal form and direction for realizing it

In order to overcome a society with high uncertainty by utilizing a rich knowledge base, we will aim to form a diverse group of universities by expanding the strengths of each university and clarifying

the missions appropriate for each university, rather than trying to achieve the same ideal form for all universities. This will enable people to choose universities based on the contents of education and research provided by universities and the added value such as the environment. Universities will support individual self-actualization based on diverse values and enrich people's lives. At the same time, by allowing human resources to flow freely in accordance with the changing times and the needs of organizations and individuals, we will create new social changes starting from universities one after another. At the same time, we will promote the further growth of research universities that are at the same level in the world among diversified universities, and aim to strengthen excellent research capabilities.

In order to realize an environment in which national universities can make full use of their originality and potential, in particular, the government will boldly shift from governance centered on the relationship with the country in which the grant for operating expenses are allocated to governance that fulfills accountability and responsibility not only to the country but also to many stakeholders including students, graduates, researchers, industry, and local communities. As a partner of the country, the government will expand the discretion of universities to realize an environment in which universities can always engage in dialogue with society. By doing so, the government will not only aim at advanced education and research as a basis for national and local knowledge, but also bear new value creation services that make the most of their intellectual assets.

At that time, research universities that rank among the world's top universities and those that serve as hubs for regional revitalization[165] inevitably differ in their stakeholders, financial structures, relationships with the government, and optimal management systems, due to the differences in their missions. In particular, in the former, bold university reforms are being carried out to realize a strong governance system, and a solid financial base will be formed by significantly expanding private funds to realize a world-class research environment and salary levels, support from newly established university funds, and enhancement of university voluntary funds.

On the other hand, universities, which should play the role of hubs for regional revitalization, will promote initiatives such as expanding the acceptance of members of society who support regional industries, creating innovation by utilizing the latest knowledge and technology and matching human resources with different fields, supporting the improvement of productivity in regional industries, securing posts where young researchers can gain experience, and improving the environment. Through these initiatives, the universities will attract investment from local communities and companies, and form an ecosystem that will lead to the development of local communities and universities. In addition, the universities will promote activities such as cooperation among multiple national, public, and private universities and research institutes.

National research and development agencies shall fulfill their responsibilities in accordance with their respective missions and characteristics. At the same time, through active collaboration and cooperation with external organizations, various financial resources, including private funds and donations, shall be secured, and the financial base shall be strengthened while steadily maximizing research and development results.

[Target]

- Diverse and unique university groups support individual self-actualization, enrich people's lives and lifestyles, and knowledge bases including excellent research capabilities drive new social changes.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- By FY2025, the amount of joint research received by universities and national research and development agencies from private companies increase by approximately 70% compared to FY2018 (restated)

---

[165] Leading universities in solving local problems such as population decline, job creation, and development of digital human resources

・ ・ Increase rate of donation income of national university corporations: increase by 5% on average per year from FY2021 to FY2025

3) Concrete measures

a. Transformation of national university corporations into a true management entity

- The government will review the ideal medium-term target in order to shift from a pre-management system based on regulations to a post-implementation check system to a true management system as a strategic organization that continues to grow as a driving force for social change for the fourth medium-term target period. In addition, the government will abolish the annual evaluation of corporations by the national government every fiscal year and review the system to evaluate business performance over a period of six years in principle. At the same time, the government will confirm reports on compliance with "the National University Corporation Governance Code[166] published by each national university corporation, ensure transparency in the state of university management and decision-making mechanisms, and fulfill accountability to relevant parties. [MEXT]

b. Deregulation to support strategic management

- From the fourth medium-term target period, the government will eliminate the involvement of the president in the university president selection committee and clarify the check-and-balance function of the university president selection committee. At the same time, the government will implement changes in the student quota of national university corporations, simplification of organizational restructuring procedures, and flexible quota management and tuition fees to secure excellent foreign students. [MEXT]
- By FY2025, the government will expand preferential treatment in the tax system for donations to universities and encourage universities to expand their own financial resources. [STI, MEXT]
- The accounting standards for national university corporations will be revised so that they can be easily understood from the viewpoints of various stakeholders. At the same time, a mechanism will be established to strategically accumulate various financial resources acquired by national university corporations, and the objective reserves will be revised so that they can be carried over to the next medium-term target period. [MEXT]
- The government will enable stable financial management by further expanding and extending the scope of bond-issuing projects by national universities and the redemption period, diversifying the financial sources for redemption and by promoting discussions on making the use of indirect expenses of public research funds more flexible (such as using them for medium-to long-term funding and facility renewal) for the fourth medium-term target period. [STI, MEXT]
- At the university support forum PEAKS by university officials, industry, and the government, management issues at universities and solutions thereof will be discussed in detail, horizontal development of good practices leading to the creation of innovation, consideration of deregulation, and development of university management will be promoted. The government will also promptly consider proposals for deregulation from the field and implement necessary policies. [STI, MEXT, METI]

c. Establishment of a 10 trillion yen university fund

- In order to overcome the current situation of declining international competitiveness and

[166] A code that serves as a basic principle for national university corporations to further enhance their functions while controlling their own management, in order to enhance their management transparency, strengthen their educational, research, and social contribution functions, and continue to fulfill their roles in response to changes in society.

weakening financial base of Japanese universities, and to further fulfill the role of universities, which should be the core of the innovation ecosystem, such as producing human resources that meet social needs, creating research results at the global level, and creating university-based start-ups that lead social change, bold investments will be made to construct a research infrastructure at the global level using unprecedented methods. Specifically, the government will construct the innovation ecosystem of Japan by providing long-term and stable support for the development of shared facilities and data collaboration infrastructure for universities that conduct research and development at a level comparable to that of the world, and the development of young human resources, by realizing a fund of approximately 10 trillion yen at an early date and utilizing its investment profits.[167] In participating in this fund, the government will seek commitment to university reforms, such as autonomous management and responsible governance, and contribution to the fund. It will also review related existing projects. In addition, the government will introduce mechanisms such as increasing the acquisition of external funds and reserving a portion of the funds to the fund from the viewpoint of the participating universities aiming at managing the fund with their own funds in the future. [STI, MEXT]

d. Diversification of public funds and governance that support the foundations of universities

- With regard to the allocation of national university corporation operating expense subsidies in FY2021, the scale of the allocation based on the performance indicators for research and education will be increased to make the allocation more varied. In addition, new allocation rules for national university corporation operating expense subsidies will be introduced and evaluated every fiscal year to make the allocation more varied for the fourth medium-term target period. For example, the common performance indicators will be carefully revised to be more objective and quantitative by utilizing e-CSTI, etc., while taking into account the missions of each university such as world-class research universities and universities that will be hubs for regional revitalization. [MEXT]
- With regard to national universities, new legal frameworks for realizing world-class research universities will be examined by the end of FY2021, and a conclusion will be reached. These include a system to check the selection method and execution of university presidents to realize strategic management, a salary and evaluation system to invite world-class researchers through a non-national government employee-type salary system, autonomous management and decision-making of student quotas and tuition fees, a new financial and accounting system to promote strategic management, and a unique government management and evaluation system. [STI, MEXT]
- In order to introduce a salary system that is not based on public service standards or seniority-based systems, such as the assignment of professionals who are required to support the strategic management of national university corporations according to their advanced specialized skills and abilities, the government will consider how to verify the salary levels of national university corporation employees. In addition, national university corporations will actively promote equal personnel exchanges not only with other universities companies, as well as other universities, and digitalization of university management in order to promote the career development and enhancement of expertise of employees who support such management. [STI, MEXT]
- With regard to the facilities of national university corporations, etc. (meaning national university corporations, inter-university research institute corporations, and national institutes

[167] The funds for major universities in the world include Harvard University (about 4.,5 trillion yen), Yale University (about 3.3 trillion yen), Stanford University (about 3.1 trillion yen) and other universities in the United States (about 65 trillion yen), Cambridge University (about 1.0 trillion yen), Oxford University (about 820 billion yen) and others.
* 2019 figures for each university and 2017 figures for the total for U.S. universities (latest values for each)

of technology; the same shall apply hereinafter), the government will aim to realize the Innovation Commons[168], a base where all players can co-create in all fields and in all scenes by organically cooperating with the entire campus. The government will formulate a facility development plan for the entire national university corporations, etc., incorporating such viewpoints, and provide continuous support. In addition, planned and focused facility development will be promoted through strategic facility development and facility management carried out by national university corporations, etc. [MEXT]

- With regard to private universities, the government will make a more balanced allocation of private school subsidies, etc. so that they can engage in high-quality education and research utilizing the spirit of establishment and the characteristics of private schools. [MEXT]
- In order to increase the value of universities as investment targets and to effectively allocate resources within universities, the government will promote the introduction of an university institutional research (IR) system, which visualizes research seeds, human resources, and other resources possessed by universities, through activities such as the university support forum PEAKS, and will promote the matching with corporate needs and the construction of a strategic university management base. [STI, MEXT]
- In order to strengthen research capabilities at universities, from FY2021, MEXT will review and strengthen its organization and systems, and will strategically and comprehensively promote measures for research personnel, funds, environment, etc. at national, public, and private universities throughout the period of the Sixth Basic Plan. [MEXT]

e. Strengthening the functional and financial foundations of national research and development agencies

- The government shall endeavor to improve investment items, taking into account the opinions of each corporation, so that national research and development agencies can fulfill their responsibilities and operate and manage operations effectively and efficiently in order to maximize research and development results. It shall also promote necessary measures to enable national research and development agencies to strengthen their financial base, such as promoting joint research with private companies. In addition, specific national research and development agencies shall create the world's highest level of research and development results and serve as the core organizations that strongly drive innovation systems. [STI, relevant ministries and agencies]

[168] Innovation Commons is a campus where students, researchers, industry, local governments, and various other players can freely gather, interact, and create new value through face-to-face and online exchanges in various fields and situations such as education, research, industry-academia collaboration and regional collaboration.

3. Education and human resource development to realize diverse happiness (well-being) and challenges for each individual

In order to proceed with the redesign of society and to create new values one after another in a society that we have not seen yet, the human resources that lead such redesign and creation are key. It is necessary to develop an environment for education and human resource development in which each person can realize a variety of happiness, and to realize learning that will produce human resources who have the ability and motivation to face challenges through trial and error in a real society where there is not necessarily a single correct answer. Human resource development under previous Science and Technology Basic Plans has been mainly targeted at human resources who are responsible for research in Japan, but with the social image of Society 5.0 in mind, it is necessary to aim at the production of human resources who can create new values in the world in a broad sense, all over Japan, regardless of generation, and the realization of an education and human resource development system that will realize it.

In order to achieve this, it is necessary to realize the learning of the Society 5.0 era from the elementary and secondary education stage. In order to strengthen the inquiring ability based on curiosity, the enhancement of problem-finding and problem-solving learning such as STEAM education will be carried out. In particular, we will develop an environment that supports learning by society as a whole, including universities and companies. In the higher education stage, the learning that responds to the diverse needs of individuals will be realized by the development of individualistic university groups. In addition, the challenge to a new career path by motivated individuals will be promoted in an environment where people can learn again throughout their lives. This will realize the growth of our country and the diverse happiness of individuals in the 100-year life era. In addition to the enhancement of recurrent education[169], the mobility of human resources will be enhanced, and the environment that makes it easy for individuals to have second jobs, side jobs, or change jobs will be developed to realize the value creation of the Society 5.0 era.

[Major goal]

- **To transform Japan as a whole into Society 5.0, we will develop human resources who will pursue happiness and face challenges.**

1) Recognition of the current situation

In the past, in Japan, uniform education and human resource development based on deviation values have been formed against the background of social homogeneity and pressure to synchronize, not only because of school education, but also because of the demand from the economic society. In the past economic growth in Japan, the existence of an education and human resource development system that met a certain level nationwide had great significance, and it functioned in a society based on the mass recruitment of new graduates by companies and the seniority system.

On the other hand, there has been no progress in diverse educational activities that included the promotion of creative challenges, nor in the active introduction of learning environments based on individual intrinsic motives and curiosity. In fact, compared with other countries, the percentage of pupils and students who do not like learning even if their grades are good is large. Awareness of these issues is already increasing not only in the educational field but also in society as a whole. As seen in the new educational guidelines and the GIGA[170] School Program, positive changes toward education in the new era are being created.

---

[169] Recurrent education can be categorized according to education, it is possible to categorize it into classes for the purpose of earning a living, for further participation in society, or for intellectual satisfaction (culture and culture). This basic plan focuses on recurrent education for the purpose of further participation in society, from the viewpoint of Society 5.0, considering new careers and those who want to take on the challenge of higher levels, while double-track career paths are required in the 100-year life span.

[170] GIGA: Global and Innovation Gateway for All

In addition, there are few people who have the will to continue to study after they have joined society as a working member, and even if they are dissatisfied with their work, they cannot overcome the current situation. This is due to the fact that the results of their studies have not been properly evaluated in society. In particular, Japanese companies tend to be negative about support for relearning and experience of second jobs and side jobs for their employees, and it has been pointed out that there are concerns on the part of companies that giving them opportunities to relearn may lead to the transfer of talented employees.

There is also a problem on the university side. In the past, the position of recurrent education in university management has not always been clarified, and it has tended to be viewed simply as secondary education for adults. However, the environment surrounding recurrent education has changed significantly, such as the diversification of work styles, double-track career paths, and the emergence of the "new normal" triggered by the coronavirus pandemic. Some universities have begun to diversify education and human resource development, including the use of MOOC.[171]

With the changes in the industrial structure and other factors, the abilities required of individuals are changing significantly, and the relationship between organizations and individuals is also changing, as seen in the shift of employment to the job type. Furthermore, due to the coronavirus pandemic, the tide of such changes is rapidly accelerating. At the same time, the form of happiness desired by the people is also diversifying, including not only economic prosperity but also the realization of qualitative prosperity under a sustainable earth.

On the other hand, the life cycle of knowledge has become shorter and shorter with rapid changes in the economic and social structures, and the age of 100 years of life has come. There is a growing possibility that people will be able to pursue various forms of happiness in accordance with their interests and interests over an unprecedented length of life.

[Current status data] (Reference index)

- The percentage of students who find arithmetic, mathematics, and science fun: arithmetic (elementary school): 77%, mathematics (junior high school): 56%, science (elementary school): 92%, science (junior high school): 70% (all in 2019)[172]
- Percentage of young people who want to be involved in solving social problems: 42.2% (FY2018)[173]
- Percentage of teachers who work more than 80 hours of overtime: elementary school 13.2%, junior high school 27.5%, and high school 19.9% (all as of June 2019)[174]
- Status of ICT environment development at schools: 60.0% for large-scale display in regular classrooms, 64.8% for integrated school operation support systems, and 7.9% for digital textbooks for learners (all as of March 2020)[175]
- Percentage of implementation of educational and training leave system: 9.4% (in FY2018)[176]
- Number of career consultants: 53,809 (end of October, 2020)[177]

2) Ideal form and direction for realizing it

We aim to develop human resources who can pursue various kinds of happiness and face up to challenges by developing the abilities and qualities important in the Society 5.0 era that will be

---

[171] An abbreviation for "Massive open online course," which is a large - -scale open online course using the Internet. It is a system in which a student can obtain a certificate of completion if he / she has completed the course and meets the completion conditions.

[172] MEXT, “Points in Trends in International Mathematics and Science Study (TIMSS 2019)”

[173] Cabinet Office, International Survey of Youth Attitude (FY2018)

[174] MEXT, “2019 Survey on the Status of Efforts for Work Style Reforms at School by the Board of Education”

[175] MEXT, “2019 Survey on the Situation of Education in Schools”

[176] MHLW, "Basic Survey on Human Resources 2018”

[177] MHLW, “Number of Persons Registered by Prefecture at the End of October 2020”

acquired through exploratory activities, such as discovering issues by oneself and seeking solutions. For this reason, from the primary and secondary education stage, children and students are encouraged to voluntarily "Why?" and "How?" to realize learning based on curiosity. This is the process of scientific research that has supported the prosperity of mankind. Such efforts are the learning itself that fosters the inquiring ability that confronts problems through trial and error.

In this process, the government will promote cooperation between school education and society by utilizing local human resources. For example, it will promote the participation of frontline researchers and entrepreneurs in the educational field, and increase students' curiosity by expanding opportunities to experience first-class and real things. Cooperation between science, technology, and innovation policies and educational policies can further enhance the effects. It will also strategically promote policy cooperation. In addition, the government will provide each student with individually optimal and collaborative educational opportunities and reduce the excessive burden on teachers in the educational field by utilizing DX and digital tools in the educational field. In doing so, idealism and ideals should not be simply imposed on the educational field, but they should be supported by society as a whole, including industries and families, by reviewing work contents and cooperating with local communities.

At the higher education stage, along with the development of university clusters as diverse and unique knowledge bases, the advancement of education at technical colleges will provide learning in accordance with the diverse needs of individuals and enrich people's lives. In particular, from the perspective of creating innovation, in the unpredictable era to come, the skills to grasp things and solve problems with multiple eyes, which goes beyond the so-called humanities and science, will become important, and the curricula and educational methods that actively teaches that will become more active.

In addition, by expanding opportunities for working people to relearn, and by encouraging individuals to engage in second jobs, side jobs, or change jobs, the government will increase the mobility of motivated and capable human resources, promote the circulation of knowledge throughout society, and lead to the creation of new value. In order to maximize the individual's abilities even after becoming a working person, the government will realize an environment in which those who wish to receive diverse and high-quality recurrent education can take advantage of a double-track career path.

[Target]

- By learning based on curiosity with the participation of various social entities, the inquiring ability is strengthened.
- Individuals find out what they want to do, and hone their abilities and qualifications.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- The government will aim to increase the percentage of elementary and junior high school students who find arithmetic, mathematics, and science to be "fun" at the elementary and junior high school levels by FY2025, with a view to achieving a level comparable to that of other countries.[178]
- By FY2022, the number of employees who participate in recurrent education at universities and technical colleges will increase to 1 million.

---

[178] According to MEXT, “Points in Trends in International Mathematics and Science Study (TIMSS 2019),”the Ministry of Education, Culture, Sports, Science and Technology's "International Survey on Mathematics and Science Education (TIMSS2019) Points", the international average percentage of students who find arithmetic, mathematics, and science to be "fun" is 84% for elementary school arithmetic, 70% for junior high school mathematics, 86% for elementary school science, and 81% for junior high school science. In Japan, only elementary school science is above the international average.

3) Concrete measures

a. Strengthening the ability to explore by promoting STEAM education

- In order to promote STEAM education, in accordance with the new high school educational guidelines, which will be fully implemented annually from FY2022, efforts will be made to enhance learning activities to discover problems and solve problems in "science and mathematics exploration" and "time for comprehensive research." In addition, outstanding R&D will be promoted at Super Science High Schools (SSH) to lead the reform of science and technology human resource development systems. With a view to disseminating and developing the results of SSH R&D to date, efforts will be made to enhance and strengthen efforts that contribute to the development of abilities through STEAM education by establishing a new system to certify high schools, etc. with a certain level of achievements by around FY2022, and by disseminating the system. [MEXT]
- The government will accelerate the development of the STEAM library[179], which can be widely used in elementary and secondary education in Japan. At the same time, the government will present model plans for educational content that can be used in elementary and secondary education and disseminate it throughout the country. In addition, in order to promote STEAM education not only in elementary and secondary education institutions but also in society as a whole, in FY2021, the government will promote the horizontal development and coordination of human resources, knowledge, and content distributed throughout the country in cooperation with platforms established by COCN[180]. In addition, in order to create educational content for elementary and secondary education based on state-of-the-art research content, the government will consider measures to incorporate research content into teaching materials that stimulate the intellectual curiosity of children and students and are appropriate as subjects, by FY2021, and draw conclusions. [STI, MEXT. METI]
- In order to greatly enhance the abilities of pupils and students with outstanding intentions and abilities and to develop the "stakes" that will emerge, the government will enhance opportunities for learning outside of schools, such as joint training camps and research presentations held by universities, private organizations, etc., and opportunities for students in Japan and overseas to develop their abilities through friendly competition, such as support for international science contests. [MEXT]
- From the perspective of education open to society, with a view to accelerating efforts toward the realization of Society 5.0, while also taking into account the latest technology trends, the government will establish a forum in CSTI to study the development of students' abilities to explore through STEAM education and the promotion of understanding of the importance of STEAM education among society as a whole. From FY2021, the government will conduct surveys and studies with the participation of members of the Central Council for Education, and will provide feedback on the results of the study on policies for science, technology, innovation, and education. [STI, MEXT]

b. Participation and utilization of external human resources in learning

- In cooperation with local universities and technology-related venture companies, examples of

---

[179] A library that can be used by anyone at any time, which has online STEAM educational material (educational material that helps foster creative value creation and problem-solving abilities, themed on the cutting-edge technologies, technology development, and the resolution of social and living issues) developed in cooperation with the education industry, schools, industrial sector, and research institutions in Japan and overseas.

[180] COCN: Council on Competitiveness-Nippon. stablished in 2006 as a voluntary organization. Since then, volunteers from the industrial sector have been engaged in activities to strengthen Japan's industrial competitiveness by compiling policy recommendations such as science, technology, and innovation policies and the division of roles between the public and private sectors.

educational and human resource development ecosystems that contribute to regional revitalization, such as creating opportunities for high school students to actually experience research activities, will be compiled by the end of 2021, and efforts will be promoted by spreading them nationwide. [MEXT]

- In order to realize diverse school education that is open to society, the government will further promote the use of the special part-time teacher system and special license certificates by, for example, promoting the dissemination to local governments in FY2021 of the Guidelines for the Examination of Educational Personnel pertaining to the granting of special license certificates, which will be revised by the end of FY2020, so that persons with a doctorate degree or persons with experience in private enterprises with excellent knowledge and experience can be invited. [MEXT]
- In FY2021, the government will investigate good practices that appropriately utilize evaluations of abilities and qualities acquired through exploratory activities[181] when selecting university students or taking employment examinations at companies, and will actively promote lateral development. From FY2022, the government will also tabulate and publicize the number (or percentage) of universities and companies that have implemented such measures.[STI, MEXT, METI]

c. Promotion of DX in the education field

- In line with the realization of one terminal per person based on the GIGA School Program, the allocation of ICT human resources in the educational field will be promoted. [MEXT]
- By the end of FY2021, the government will publish the Educational Data Standard (2nd edition) so that individual children and students can reflect on their own learning by using educational data generated through daily learning, teachers can provide individually optimum learning guidance and student guidance, and new knowledge such as teaching methods and learning methods can be created and reflected in the planning and formulation of policies by national and local governments. [MEXT]
- By FY2022, the government will complete the introduction of an integrated school administration support system that can reduce the workload of teachers. [MEXT]

d. Promotion of human resource mobility and reinforcement of learning for career change and career advancement

- By FY2023, the government will establish nationwide systems of cooperation and collaboration with local industries, domestic and overseas universities, and international organizations so that high school students can take active action toward their future by expanding opportunities to realize learning in cooperation and collaboration with industry, universities, and international organizations in order to resolve regional and global social issues. [MEXT]
- In FY2021, the government will start coordinating the functions of the vocational information service site (Japanese Version of O-NET[182]), which started its operation in FY2019, and the site introducing programs for adults at universities (Manapass[183]). In addition, the government

---

[181] For example, "knowledge and skills", "thinking ability, judgment ability, and expression ability", and "an attitude of having independence and learning in cooperation with various people" (three elements of academic ability) acquired in the high school stage are mentioned.

[182] Aiming to "visualize" the labor market, MHLW established a job information site in March 2020 that provides comprehensive job information, including explanations of about 500 jobs including video content and "numerical data" such as required knowledge and skills.

[183] A portal site for adults that provides information on relearning courses at universities and support systems for relearning, which means "passport for learning." Established and operated by Maruzen-Yushodo Company Co., Ltd., commissioned by MEXT in FY2018 for the "Practical Research for Improving Access to Information on Learning by Adults."

will strengthen the functions of these two sites by FY2022. The government will also improve and further disseminate the expertise of career consultants. Through these efforts, the government will develop an environment in which individuals can easily take steps toward career advancement and career change. [MEXT, MHLW]

- The relevant ministries and agencies will cooperate to promote the utilization and expand the spread of the professional engineer system in the industrial arena, etc., as well as make the necessary revisions to the system in order to secure international applicability, promote the entry of young human resources, and improve the quality and ability of professional engineers. [MEXT, relevant ministries and agencies]
- The government will create opportunities for the development and active participation of innovative human resources in order to increase the depth of a diverse range of innovative human resources, including management human resources involved in the creation of innovation, and to improve the quality of human resources by increasing their mobility. To this end, the government will, by FY2023, engage in conducting a fact-finding survey on the development of an environment for developing innovative human resources and disseminate best practices, taking into account the accumulation of discussions on human resource development. (Restated) [METI]
- In order to improve the mobility of research personnel between universities and corporations, the Guidelines for Industry-Academia-Government Collaboration shall be disseminated to promote the utilization of cross-appointment systems and concurrent employment at each institution, the implementation of risk management for conflicts of interest, etc., and the relaxation of organizational rules, etc.[MEXT, METI]

e. Fostering an environment and culture that encourages society and companies to continue to learn

- By FY2023, the government will develop indicators for evaluating the effects of recurrent education on society, in addition to the number of employees who have participated in such education. [STI, MEXT, MHLW, METI]
- From the perspective of creating an environment in which individuals can make the most of their abilities by relearning even after they have reached a certain age, from FY2021, the relevant ministries and agencies will jointly study concrete measures to promote the utilization of the educational training leave system and the introduction of recurrent education for employees in companies, in order to contribute to the continuation of individual learning supported by work style reform, while taking into account the movement of employment to the job type, and summarize the results. [STI, MEXT, MHLW, METI]
- Companies that provide sabbatical leave and economic support to employees for relearning will be evaluated as leading companies in human resource development, and measures will be introduced to improve their corporate image. [METI]
- The government will make efforts to accelerate joint research and joint education between companies and universities that will contribute to both the expansion of career paths for doctoral researchers to the industrial sector and relearning for corporate human resources. [METI]

f. Provision of diverse curricula and programs at universities and national institutes of technology

- The government will develop a group of universities that support individual self-actualization based on various values. Specifically, in higher education, students, who are the most important stakeholders as recipients of higher education and are members of universities, are regarded as

those who share long-term interests in the development of universities. In addition to requiring the publication of information to national universities about the educational outcomes that students were able to enjoy under the Governance Code, each university will conduct surveys, analyses, and verifications, including long-term perspectives such as student satisfaction and how students' abilities are evaluated by society after graduation. The results of these surveys, analyses, and verifications will not only be linked to education courses and the selection of new students, but also to enhance information disclosure in a comparable manner so that students can make appropriate choices for universities, thereby explaining education to students and the people who can become students and fulfilling their responsibilities as a result. [STI, MEXT]

- The government will encourage the active utilization of a degree program system that allows students to establish curricula beyond the boundaries of faculties and graduate system that allows students to acquire degrees such as double majors. In addition, in order to realize a wide range of liberal arts education across the humanities and sciences in university education, the government will use such a system to construct multiple new types of educational programs (late specialization program, etc.) that are both broad and deep through all-university common education and graduate education. [MEXT]
- In line with the fourth medium-term target period for national university corporation from FY2022, the government will actively evaluate universities whose management is based on recurrent education based on regional issues and university strengths. At the same time, the government will actively promote cooperation between the liaison functions of organizations such as the Center for Industry-Academia Collaboration and the Center for Regional Collaboration, which accumulate information on the needs of local industries, and recurrent education and human resource development programs that respond to the needs of local industries, and will secure specialized human resources who will play the role of coordinators, such as program design and public reports. [MEXT, METI]
- In order to promote strategic implementation of the functions of recurrent education and human resource development by universities in cooperation with external organizations, the government will develop an environment that enables all national university corporations to invest in enterprises that implement training and training. [MEXT]
- Utilizing a variety of digital content including MOOC, we will expand recurrent education programs for members of society, etc. For this purpose, we will design incentives for universities, etc., such as certification and systematization of courses that are considered to be particularly effective for recurrent education for members of society, etc. We will also consider the establishment of a system to realize university education in the new normal system, which allows a variety of learners to learn from each other, such as face-to-face and online hybridization. We will draw a certain conclusion by the end of FY2021, including the flexibility of university establishment standards. [MEXT, METI]
- With regard to national institutes of technology, in order to improve education for the development of practical engineers, the government will promote the participation of persons who are active in the front lines of companies in education as teachers, and from FY2021, the government will establish a human resource development system to solve social issues requiring a wide range of knowledge and skills, such as disaster prevention, disaster reduction and epidemic prevention, in addition to nursing care, medical engineering, and materials, by integrating AI and other fields. [MEXT]

g. Joint creation of knowledge and strengthening of science and technology communications through participation of various entities such as citizen participation

- From FY2021, multi-layered science and technology communications will be strengthened, including efforts for science and technology literacy and risk literacy based on social events and social changes caused by the novel coronavirus pandemic, efforts to collect opinions from the general public at science museums and other museums, efforts to participate in policy processes by citizens, and efforts to engage in dialogue and collaborative activities that

overcome differences in age, gender, physical ability, values, etc., utilizing state-of-the-art technologies essential for the realization of Society 5.0 such as IoT and AI. [STI, MEXT]

- In order to promote science and technology literacy, risk literacy, and co-creation research activities, proactive activities by science and technology communicators are essential as human resources who play a role in connecting various entities. The government will support such efforts. [MEXT]
- The government will promote research activities such as the creation and fusion of knowledge by co-creating with various entities such as local governments, NPOs and NGOs, small and medium-sized enterprises and start-ups, freelance researchers, and citizen participation. In addition, the government will implement the development of an environment that encourages the participation of various entities as a new science, technology, and innovation policy formulation process as a bottom-up approach by industry, academia, and government, such as the launch of citizen science research projects that expect the participation of many citizens by collecting many samples and conducting scientific experiments that cannot be realized by researchers alone (on a scale of 10,000 people, with the assumption that it will start by FY2022). (Restated) [STI, MEXT]

Chapter 3 Strengthening the System for Promoting Science, Technology, and Innovation Policies

This chapter summarizes the securing of public and private R&D investment to promote science, technology, and innovation policies toward the realization of the Society 5.0 shown in Chapter 2, sectoral strategies promoted through public-private partnership, and the strengthening of the control tower function of CSTI.

1. Revitalization of the financial cycle for the creation of knowledge and value

1) Recognition of the current situation

Science, technology, and innovation are indispensable for solving the global agenda on infectious diseases, climate change, resources and energy, population, food, and universal health coverage (UHC)[184], and for strengthening international competitiveness. Foreign countries are planning large-scale investments in science, technology, and innovation.[185]

The five Basic Plans thus far sets clear targets for government R&D investment, steadily secures science and technology-related budgets, and induces private-sector R&D. However, compared with other countries, the decline in research and innovation power and the delay in digitalization have become apparent.

On the other hand, as the environment surrounding the economy and society has changed significantly due to the outbreak of the novel coronavirus, it has become increasingly necessary for companies not only to pursue profits, including environmental issues, but also to attach importance to the creation of common value (CSV[186]). Investment with a different value axis from that of the past, such as ESG investment[187] and impact investment[188], have attracted attention.

Under these circumstances, in order to contribute to the expansion of R&D investment in the future, preparations were made for the period of the Sixth Basic Plan. For example, in the third supplementary budget for FY2020, 2 trillion yen was allocated for green innovation fund projects to provide continuous support for the development of innovative technologies toward carbon neutrality, and 500 billion yen was included for the establishment of a university fund on a scale of 10 trillion yen to build a world-class research infrastructure.

The next five to 10 years will be a watershed for whether Japan can continue to be one of the world's leading front runners. Japan must identify the winners and stimulate bold investment, including promotion of new investment such as ESG investment and impact investment.

[Current status data] (Reference index)

- Total public and private R&D expenditure: 3.50% (FY2019) against a target of 4% of GDP[189]

---

[184] It refers to the condition in which all people can receive appropriate health and medical services such as prevention, treatment and rehabilitation at affordable cost, and is positioned as one of the targets of SDGs.

[185] As examples of additional investment for R&D by various foreign governments with an eye to a post-coronavirus era, the United States is planning an increase of approximately 10 trillion yen in five years, the UK approximately 3 trillion years in five years, Germany approximately 6 trillion yen (of which the major R&D support will be approximately 2 trillion yen in two years), and France approximately 3 trillion yen in ten years. All figures are investigated and estimated by the Cabinet Office based on new reports, etc.

[186] CSV: Creating Shared Value.

[187] In order to measure a company's value in order to make investments that takes into account not only financial information but also non - -financial ESG (Environment, Social, Governance) factors.

[188] An ESG investment that provides an economic return and a positive, measurable social and environmental impact.

[189] "MIC, Survey on Science and Technology Research 2020," Ministry of Internal Affairs and Communications, December 2020

- Science and technology budget during the Fifth Basic Plan: approximately 26.1 trillion yen (when including the green innovation fund projects and university fund on a scale of 10 trillion yen: 28.6 trillion yen)[190] (as of March 2021)
- Total budget execution amount of research expenses by national university corporations, research and development agencies and inter-university research institute corporations: approximately 600 billion yen (FY2018)[191]
- Investment in intangible assets in Japan, including investment in corporate capacity development: 53.9 trillion yen (2015)[192]
- ESG investment: investment balance in Japan: approximately 336 trillion yen (2019)[193]
- Impact investment: investment balance in Japan: approximately 317.9 billion yen (2019)[194]

2) Ideal form and direction for realizing it

In addition to investing in activities aimed at creating knowledge and creating economic and social values to realize Society 5.0 (according to calculations by the Keidanren, etc.[195], a cumulative investment of 844 trillion yen is required over 15 years to 2030), the government will aim to significantly expand public and private investment while utilizing a variety of financial resources to expand business.

To this end, the government will secure sufficient investment in basic research by steadily securing science and technology-related budgets, promoting industry-academia joint research, and establishing funds that are equal to those in the world. At the same time, the public and private sectors will cooperate and cooperate to strengthen responses to important national issues.

In addition to these, the government will mobilize all policy tools such as the research and development tax system, the SBIR system, innovation in government projects, and promotion of public procurement of research results, in order to create an environment conducive to private investment, and to promote innovation management that places sustainability at the core of business.

[Target]

- While other countries are planning large-scale R&D investment in anticipation of the post-coronavirus era, Japan will secure bold-scale government R&D investment in order to win the fierce competition among countries.
- We will also try to induce private R&D investment.

[Major Numerical Targets for Science, Technology, and Innovation Policies] (Major Indicators)

- Total government R&D investment[196] from FY2021 to FY2025: approximately 30 trillion yen

---

[190] While maintaining consistency with the economic and fiscal rehabilitation plan, the target was set at 1% of the GDP, and the target was set aiming at about 26 trillion yen when calculated based on the assumption that the nominal GDP growth rate during the period would be 3.3% on average..

[191] Of the total of 119 institutions identified by e-CSTI, 604.7 billion yen was collected for researchers aged 26 to 70 from 117 institutions.

[192] JIP Database 2018. The ratio of Japan's investment in intangible assets to GDP is low compared with other countries. In particular, investment in economic competitiveness has remained low.

[193] Sustainable Investment Survey 2019

[194]' GSG National Advisory Committee' Current Situation of Impact Investment in Japan 2019, Revised Edition (2020)

[195] Joint report "Evolution of ESG Investment, Realization of Society 5.0, and Achievement of the SDGs" (March 26, 2020) by the Keidanren, the University of Tokyo, and the GPIF

[196] Considering the diversification of funding sources for investment in science, technology, and innovation policies, including the establishment of university funds, the government will consider appropriate methods for identifying R&D investment during the period of the Sixth Basic Plan, while paying attention to trends in the OECD Frascati Manual.

- From FY2021 to FY2025, the total amount of R&D investment by the public and private sectors combined: approximately 120 trillion yen (taking into account the level of the ratio of Japan's government-funded R&D expenditures, as well as the synergistic effect of the promotion of private investment through the use of government investment as a trigger)

3) Concrete measures

a. Expansion of public and private investment

- The government budget for science and technology shall be expanded during the period of the Sixth Basic Plan, taking full account of the constant improvement of the quality of science, technology, and innovation policies and the fiscal sustainability. [STI, relevant ministries and agencies]
- In order to promote the development of shared facilities and data collaboration infrastructure and the development of young human resources at universities that conduct R&D at a level comparable to that in the world, the government will construct a world-class research infrastructure by promptly realizing a fund approximately 10 trillion yen and utilizing its investment profits. [STI, MEXT]
- From the perspective of strengthening Japan's basic research capabilities, the trend of research expenditures at national, public, and private universities and inter-university research institutes will be analyzed and monitored. [MEXT]

b. Development of private investment environment

- The R&D tax system will be enhanced in order to encourage the medium- to long-term and innovative R&D of private enterprises, maintain and expand R&D investment, and thereby create knowledge, value, and innovation. [METI, relevant ministries and agencies]
- In order to continuously create knowledge and value, the government will endeavor to build a brand, improve management organizations, improve the quality of human resources through education and training, and create an environment conducive to investment in intangible assets such as software and databases. [METI]
- The government will promote ESG finance and impact finance as a form of development of ESG finance to mainstream finance that pursues positive impact on society, the economy, and the environment. In particular, the government will aim to ensure that all institutional investors and financial institutions implement impact finance in all asset classes. In FY2021, the government will develop a promotion system for major financial institutions and institutional investors, and as the next step, the government will encourage a ripple effect on efforts towards regional financial institutions and small and medium-sized, and individual investors . [FSA, METI, MOE]
- Society 5.0 Indicators will be developed by the end of FY2022 to grasp the status of investment toward realization. [STI]

2. Promotion of sectoral strategies through public-private partnerships

During the period of the Fifth Basic Plan, the government formulated sectoral strategies in each field: AI technology, biotechnology, quantum technology, and materials as basic fields; and environment and energy, safety and security, health and medical care, space, ocean, food, agriculture, forestry, and fisheries as application fields. Based on these strategies, the following points will be taken into consideration during the period of the Sixth Basic Plan. Social implementation and R&D will be steadily implemented in cooperation with related projects such as SIP and Moonshot Research and Development Programs.[197] The strategies for each field will be formulated and revised flexibly based on quantitative analysis and expert knowledge (expert judges).

The environmental and energy fields are described in Chapter 2, 1. (2), and the safety and security fields are described in Chapter 2, 1. (3). Therefore, refer to the relevant sections.

1) AI technology

The utilization of artificial intelligence (AI) has been widely advancing in society, and countries such as the United States and China have formulated national strategies on AI and are competing to lead the world. In these circumstances, it is necessary to promote appropriate development and social implementation based on the fact that AI brings great benefits to society and has a great influence on society.

For this reason, during the period of the Sixth Basic Plan, efforts will be made by the relevant ministries and agencies in order to realize concrete goals set forth in AI Strategy 2019, such as educational reform, restructuring of research systems, social implementation, development of data-related infrastructure, and ethics. In addition, the government will continuously review the progress of strategies and the progress of social implementation of AI, and will promote strategies so that each and every citizen can feel the specific benefits of AI, by securing and strengthening advanced R&D, human resources, research environments, and data that are comparable to those in other countries, such as next-generation machine learning algorithms based on the principles of deep learning, advanced natural language processing such as simultaneous interpretation, and highly reliable AI that is important for application to medical care and manufacturing fields.

2) Biotechnology

The promotion of the bioeconomy contributes to responses to the convergence of the novel coronavirus infection, the construction of strategic supply chains for food and pharmaceutical products, and the reduction of environmental impact. It also contributes to the rapid recovery of the Japanese economy, and its importance is further increasing.

Based on this recognition, during the period of the Sixth Basic Plan, the government will steadily implement measures incorporated in the Market Domain Roadmap, which sets market size targets as of 2030, in nine market domains, including high-performance bio-materials, sustainable primary production systems, and biopharmaceuticals and regenerative medicine-related industries, based on Bio Strategy 2019 (Basic Policies)[198] and Bio Strategy 2020 (Definitive Measures for Market Domains)[199], which embody and update Bio Strategy 2020[200]. Specifically, the government will formulate guidelines for collaboration and utilization of bio-data and promote measures based on the guidelines, promote the formation and investment of global and regional bio-communities, and develop bio-manufacturing demonstration and human resource development base functions in global bio-communities, in accordance with each field.

3) Quantum technology

Quantum technology is an innovative technology that has the potential to bring about major

---

[197] The SIP (second phase) R&D themes and Moonshot Research and Development Program objectives are as shown in [Reference] of this section.
[198] June 11, 2019 Decision of the Integrated Innovation Strategy Promotion Council
[199] June 26, 2020 Decision of the Integrated Innovation Strategy Promotion Council
[200] January 19, 2021 Decision of the Integrated Innovation Strategy Promotion Council

changes in the society, economy, industry, and security of Japan and the world. In recent years, competition between countries and companies has intensified in various countries, including the United States, European countries, and China. Each country has been engaged in large-scale investment and large-scale-scale R&D. Thus, competition between countries and companies that will exert hegemony in the future has intensified. In Japan, too, strategic efforts are required for R&D of quantum technology and their implementation in society.

For this reason, during the period of the Sixth Basic Plan, based on the Quantum Technology and Innovation Strategy[201], the government, industry, academia and the government will strongly promote a wide range of initiatives ranging from basic and basic R&D to implementation in society, including the promotion of utilization of quantum technology in industry and society, including practical application of quantum technology in the short and medium term by combining existing technologies, in addition to the fundamental strengthening of R&D on key technologies such as quantum computers, quantum measurement and sensing, quantum communication and cryptography, etc., formation of innovation bases, promotion of international cooperation, strategic intellectual property management and international standardization, and development of excellent human resources.

4) Materials

Materials are a basic technology that supports Japan's science, technology, and innovation. They have also produced numerous innovations such as lithium-ion batteries and blue light-emitting diodes, and have supported the world economy and society. On the other hand, in recent years, as international competition for materials has intensified, Japan has lost its strength in this field, and it is necessary to strengthen strategic efforts while taking advantage of the remaining strength.

For this reason, during the 6th Basic Plan period, based on the Strategy for Strengthening Material Innovation Capabilities[202], the government will vigorously promote the initiatives set forth in the strategy under the common vision of industry, academia, and government, by utilizing the strengths of Japan, which has the world's highest level R&D infrastructure with a large number of diverse researchers and companies in Japan, such as the rapid implementation of society through industry-academia co-creation, the creation of new value through the development of a data-driven R&D infrastructure and the pursuit of the essence of things, and the securing of sustainable development such as human resource development.

5) Health and medical care

In the midst of the 4th Industrial Revolution[203], R&D is advancing in the medical and life science fields worldwide, and as innovation in these fields accelerates, it is expected that elucidation of disease mechanisms, development of new diagnostic and treatment methods, R&D of drug discovery using AI, big data, etc., and personalized medicine and precision medicine tailored to individual conditions will advance.

Against this background, during the period of the Sixth Basic Plan, based on the Healthcare and Medical Strategy[204] and the Plan for Promotion of Medical Research and Development[205] for the second period covering FY2020 to FY2024, the government will promote integrated research and development from the basics to practical application in the medical care field in cooperation with other

---

[201] January 21, 2020 Decision of the Integrated Innovation Strategy Promotion Council
[202] Currently under the consideration of the Integrated Innovation Strategy Promotion Council as of March 2021.
[203] The 4th Industrial Revolution refers to the industrial revolution with several core technological innovations such as IoT, big data and AI following the 1st Industrial Revolution, which was the mechanization of factories by hydraulic and steam engines since the end of the 18th century, the 2nd Industrial Revolution, which was the mass production using electricity based on the division of labor in the early 20th century, and the 3rd Industrial Revolution, which was the further automation using electronics and information technology since the early 1970s.
[204] Cabinet decision of March 27, 2020
[205] Decision of the Headquarters for Healthcare and Medical Strategy Promotion, March 27, 2020

funding agencies, in-house research institutes, and private companies, with support from AMED[206] at the core, as the promotion of research and development in the medical care field. As a particularly pressing issue, the government will concentrate support for research and development in order to put into practical use a domestic vaccine, drugs, etc. for the novel coronavirus infection at an early stage. In addition, for the development of the medical care field R&D environment, the government will promote the development of systems and mechanisms at specialized human resources such as biostatisticians and regulatory science experts, and the dissemination and enhancement of regulatory science in research and development, as the improvement of the medical care research and development environment. In addition, the government will promote health management for the promotion of health care industries other than public insurance, the promotion of regional and occupational partnerships, and the promotion of efforts for individual health, as the creation of new industries and their international expansion. In addition, the government will promote the international expansion of Japan's health and medical care-related industries under the Asia Health and Wellbeing Initiative[207] and the African Health Initiative[208] with the aim of contributing to the achievement of universal health coverage (UHC), with the aim of promoting autonomous industries in each country and contributing to the wide range of health and medical care fields.

6) Space

Today, space systems such as positioning, communication, and observation support Japan's security and economic and social activities. They are also becoming increasingly important as a basis for realizing Society 5.0. Under these circumstances, space activities have entered an age of co-creation by the public and private sectors, and efforts are being made to vitalize industries through space utilization in a wide range of fields. In addition, with the progress of space exploration, the sphere of human activities is expanding beyond the earth's orbit to the moon surface and deep space, and the success of the collection of samples from asteroids by Hayabusa 2 has demonstrated to the world the high level of Japan's science and technology, raising public expectations for its power. Space is becoming increasingly important as a driving force for the frontier of science and technology and economic growth, and it can be a major driving force in the creation of innovation in Japan.

Based on this recognition, during the period of the Sixth Basic Plan, based on the Basic Plan on Space Policy[209], the government will promote, in cooperation with industry, academia, and government, development for quasi-zenith satellite systems and information-gathering satellites, satellite development that contributes to disaster countermeasures and national resilience and the resolution of global issues, research and development for lunar exploration under the Artemis program, promotion of space science and exploration, development and upgrading of key rockets, examination of future space transportation systems, promotion of strategic satellite development and demonstration in cooperation with each ministry, expansion and upgrading of satellite data use, formation of rules for future space activities including space debris countermeasures and space transportation management, and strengthening of the human resource base that supports space activities.

7) Ocean

For Japan, which is surrounded by the sea on all sides and has one of the largest control areas in the world, it is necessary to protect the ocean[210] in order to preserve its territory and territorial waters and ensure the safety of its people, to make use of the sea as a basis for the existence and growth of

---

[206] AMED: Japan Agency for Medical Research and Development

[207] Basic Policy for the Asian Health and Wellbeing Initiative (Decision of the Headquarters for Healthcare and Medical Strategy Promotion, July 29, 2016. Revised July 25, 2018)

[208] Basic Policy for the African Health Initiative (Decision of the Headquarters for Healthcare and Medical Strategy Promotion, June 20, 2019)

[209] Cabinet decision of June 30, 2020

[210] Japan ranks sixth in the world in terms of the area of its territorial waters (including inland waters) and exclusive economic zones, and eighth in the world in terms of the sea areas owned by each country's overseas territories.

economic society, and to pass on the sea to its descendants as a basis for the existence of precious human beings. In addition, it is essential to collect and utilize scientific knowledge on the ocean in the following areas: conservation of marine living resources and ecosystems, securing of energy and mineral resources, response to global-scale issues such as global warming and marine plastic waste, measures against threats such as earthquakes, tsunamis, and volcanoes, sustainable use and utilization of the Arctic region, and strengthening of competitive power in the marine industry. In the United Nations Decade of Ocean Science for Sustainable Development (2021), it is necessary to contribute to the world with the power of science and technology, which is Japan's strength.

Therefore, during the period of the Sixth Basic Plan, the government will comprehensively and systematically promote measures relating to the oceans based on the Basic Plan for Ocean Policy[211]. In particular, ocean observation is the most important foundation for ocean science and technology. In order to strengthen the capacity of MDA[212] and to enhance the ability to understand the vast marine environment for realizing carbon neutrality, the government will develop observation technologies such as research vessels, ROVs[213], AUVs[214], submarine optical fiber cables, unmanned observation boats, etc., with the aim of improving ocean survey and observation technologies including those for ice areas, deep sea areas, and subseafloor. In addition, the government will aim for thorough utilization of observation data by building and strengthening a common base for data and calculations in order to advance the sophistication of data and information processing, sharing, and utilization. At the same time, the government will also aim to create marine value, which is an asset of mankind as a whole, through the promotion of data-driven research in the ocean field by realizing the Internet of Laboratory[215] for ocean observations.

In order to promote these activities, we will strongly promote industry-academia-government collaboration and aim to create innovation in the maritime field.

8) Food, agriculture, forestry, and fisheries

Today, it is necessary to protect and develop Japan's abundant food and environment by utilizing the power of science and technology, and to strengthen the international competitiveness of the agriculture, forestry, and fisheries industries in order to expand exports by capturing expanding overseas demand. In particular, in order to respond to the diverse needs of farmers, it is necessary for farmers to dramatically improve productivity and contribute to income growth by fully utilizing data and implementing innovative agriculture incorporating smart agricultural technology.

For this reason, during the period of the Sixth Basic Plan, the Ministry of Agriculture, Forestry and Fisheries formulates the Strategy for Research and Innovation Concerning Agriculture, Forestry and Fisheries every fiscal year based on the Basic Plan for Food, Agriculture and Rural Areas[216] and promotes smart agriculture, forestry and fisheries policies, environmental policies, and biotechnology policies in cooperation with various fields other than agriculture, forestry, and fisheries. Among these policies, the Ministry will contribute to the improvement of Japan's agricultural brand power and the reduction of food loss by deploying production bases utilizing Japan's smart agriculture technologies and systems in the Asia-Pacific region and other regions. In the forestry and fisheries sectors, the Ministry will also steadily implement new technologies such as ICT, AI forestry and fisheries sectors. In addition, based on the Plan to Create Dynamism through Agriculture, Forestry, and Fisheries and

---

[211] The Third Basic Plan for Ocean Policy was approved by the Cabinet on May 15, 2018. The Basic Act for Ocean Policy stipulates that the Basic Plan for Ocean Policy shall be reviewed approximately every five years.

[212] MDA: Maritime Domain Awareness

[213] ROV: Remotely Operated Vehicle (ROV)

[214] AUV: Autonomous Underwater Vehicle (ROV)

[215] A system in which various devices and data can be connected in real time through a network infrastructure that enables large - -capacity data communications, and research activities can be conducted seamlessly regardless of location.

[216] Cabinet decision of March 31, 2020

Local Communities[217], the Green Food System Strategy, which will be formulated by May 2021, and demonstrate the vision for 2050 to realize both the productivity improvement and the sustainability of food, agriculture, forestry and fisheries through innovation.

[217] Decision of the Headquarters for the Revitalization of Food, Agriculture, Forestry, and (chair: Prime Minister) on December 10, 2013(revised on December 15, 2020).

[Reference] SIP (Phase 2) Research and Development Themes and Moonshot R&D Program Objectives (as of December 2020)

- **SIP (Phase 2) Research and Development Themes (from FY2018)**

・Cyber space infrastructure technology utilizing big data and AI
・Physical space digital data processing infrastructure
・Cyber-physical security for an IoT society
・Autonomous driving (expansion of systems and services)
・Material revolution by integrated material development system
・Realization of Society 5.0 through light and quantum technologies
・Smart bio-industry and basic agricultural technologies
・Energy system of an IoE society
・Strengthening national resilience (disaster risk reduction and mitigation)
・Advanced diagnostic and treatment systems using AI (artificial intelligence) hospitals
・Smart logistics services
・Innovative deep sea resources survey technology

- **Moonshot R&D Program Objectives**

1. By 2050, we will realize a society in which people are free from restrictions of body, brain, space, and time.
2. By 2050, we will realize a society capable of predicting and preventing diseases at an extremely early stage.
3. By 2050, we will realize robots that learn and act by themselves and live in harmony with humans through the coevolution of AI and robots.
4. By 2050, we will realize sustainable resource circulation for global environment restoration.
5. By 2050, we will create a sustainable food supply industry on a global scale that is free of overwork and waste by fully utilizing unused biological functions.
6. By 2050, we will realize error-tolerant general-purpose quantum computers that will dramatically improve the economy, industry, and security.
7. By 2040, we will realize a sustainable medical and nursing care system that prevents and overcomes major diseases and enables people to enjoy their lives without worrying about their health until they reach 100 years old.

3. Strengthening the control tower function of the Council for Science, Technology, and Innovation

(1) Strengthening functions that utilize the convergence of knowledge and drafting policies and transmitting information for the future

In order to solve social issues, it is necessary to present new values and to take a systematic approach, in addition to the approaches that are an extension of conventional approaches. In order to respond to issues such as the institutional and ethical aspects and social acceptance that arise when new technologies are used in society, we will construct a system that can utilize the convergence of knowledge including the humanities and social sciences. In this process, in 2030, we will draw up a social image for which to aim further down the road, and systematize policies by taking a back-cast approach from that social image. In addition, we will firmly grasp and analyze the current situation, formulate new policies for the future by taking a forward-cast approach, and take a foresight approach by combining these.[218]

In policy formulation, multi-layered science and technology communication with society and information transmission to the public and diverse sectors are also important. In light of the importance of Science for Policy in an age in which trans-science[219] is emphasized, it is important for academia, politics, and administration to share a recognition of issues and assumptions, and to provide independent and appropriate advice and recommendations based on scientific knowledge. For example, the establishment of a mechanism to connect these parties will be examined.

(2) Strengthening policy-making functions and ensuring the effectiveness of policies through the use of evidence systems (e-CSTI)

In science, technology, and innovation administration, the EBPM of policy formulation based on objective evidence shall be thoroughly implemented, and policy formulation based on evidence shall be carried out in all relevant ministries and agencies by FY2023. In doing so, the performance of management of government R&D investment that serves as a catalyst for private investment, various measures including advanced corporate management (EBMgt[220]) in national universities and research and development agencies, and national strategy planning shall be improved by utilizing the evidence system (e-CSTI).

(3) Implementation of policy evaluation linked to the Sixth Basic Plan and formulation of integrated strategy

Based on the direction of medium- and long-term policies indicated in the Sixth Basic Plan, the Integrated Strategy has been formulated as an annual strategy since FY2013, and measures that should be given special emphasis in that fiscal year have been determined based on the changes in the situation every year.

During the period of the Sixth Basic Plan as well, measures that should be given particular emphasis in each fiscal year will be indicated in the annual strategy by clarifying their relevance to the Sixth Basic Plan. In this regard, the progress of the Sixth Basic Plan will be continuously monitored and evaluated by an expert committee for evaluation using indicators. The results will be used in the formulation of the Annual Strategy and the next Basic Plan. In addition, the Sixth Basic Plan will be revised as necessary to promote flexible science, technology, and innovation policies in response to changes in social conditions, etc. For this purpose, the functions of e-CSTI will be continuously expanded, the collection of monitoring indicators will be automated, and the basis for cross-sectoral evaluation will be put into operation by the end of FY2023. In addition, research and studies will be carried out to upgrade the EBPM, including the development of analytical methods, and the indicators will be continuously improved and revised.

---

[218] An activity in which various pieces of information are combined to examine a rapidly changing, complex and uncertain future.

[219] A question that can be asked of science but cannot be answered by science alone

[220] Management based on evidence

(4) Ensuring the effectiveness of the control tower function

Command and control centers such as CSTI, the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society, the Intellectual Property Strategy Headquarters, the Headquarters for Healthcare and Medical Strategy Promotion, the Strategic Headquarters for National Space Policy, and the Headquarters for Ocean Policy, all of which are closely related to science, technology, and innovation policies, are required to strengthen their command-and-control functions to coordinate policies across-the-board. To this end, the Act for Establishment of the Cabinet Office was amended to establish the Office for the Promotion of Science, Technology, and Innovation in April 2021.

With regard to science, technology, and innovation-related policies promoted by related command and control centers and related ministries and agencies, a system will be established as soon as possible so that the secretariat can effectively work out coordination functions such as eliminating overlapping policies and promoting collaboration.

In order to realize Society 5.0, CSTI will further deepen cooperation with the above-mentioned command and control centers and the Science Council of Japan, and strengthen cooperative relations with various councils of relevant ministries and agencies in policy studies. In addition, based on the progress of concrete reform of the Science Council of Japan in order for it to play a better role as the representative institution of scientists in Japan, new cooperative relations will be established according to the roles required of the Science Council of Japan.

List of Abbreviated Names

The abbreviated names of the ministries and agencies used within the brackets in the respective sections of Chapter 2 and Chapter 3 are as follows.

Abbreviated Name	Ministry or Agency		
CBPA	Cabinet Secretariat	Cabinet Bureau of Personnel Affairs	
IT		Information Technology (IT) Comprehensive Strategy Office	
G-space		Office for the Advancement of Utilizing Geospatial Information	
Expo		Secretariat of the Headquarters for the World Expo	
NPA	National Personnel Authority		
Reconstruction	Reconstruction Agency		
Social Systems	Cabinet Office	Director General for Economic, Fiscal and Social Structure	
Regulations		Council for Promotion of Regulatory Reform	
STI		Secretariat for the Promotion of Science, Technology, and Innovation*	
Health		Headquarters for Healthcare Policy*	
DISASTER		Director General for Disaster Management	
Gender Equality		Gender Equality Bureau	
OPDVLE		Office for the Promotion of Overcoming Population Decline and Vitalizing Local Economy in Japan	
SIPSH		Secretariat of the Intellectual Property Strategy Headquarters	
SPACE		National Space Policy Secretariat	
CCRA		Child and Child-Rearing Administration	
OCEAN		National Ocean Policy Secretariat	
JFTC		Japan Fair Trade Commission	
NPA		National Public Safety Commission	National Police Agency
PPC		Personal Information Protection Commission Secretariat	
FSA		Financial Service Agency	
MIC	Ministry of Internal Affairs and Communications		
MOFA	Ministry of Foreign Affairs		
MEXT	Ministry of Education, Culture, Sports, Science and Technology		
MHLW	Ministry of Health, Labour and Welfare		
MAFF	Ministry of Agriculture, Forestry and Fisheries		
METI	Ministry of Economy, Trade and Industry		
MLIT	Ministry of Land, Infrastructure, Transport and Tourism		
MOE	Ministry of the Environment		
OD	Ministry of Defense		

*From April 2021