Chapter 1 Prediction of the Future Through Science and Technology

Humanity is facing a variety of global challenges, including water and food shortages due to the explosive growth of the world's population, global warming and climate change, as well as increasing poverty and disparity, and the spread of emerging and re-emerging infectious diseases such as COVID-19. Under these circumstances, the 2030 Agenda for Sustainable Development, which sets forth the Sustainable Development Goals (SDGs), was adopted in 2015 with the support of all UN member countries and with their commitments to do their utmost to achieve them.

■Figure 1-1-1/Sustainable Development Goals (SDGs)

Source: United Nations Information Centre

It is said that in order to achieve the SDGs, backcasting is more valuable than forecasting. In backcasting, a desirable future society is first defined and then the steps that need to be taken now are determined, whereas in forecasting a goal is set according to what is considered feasible based on the current situation.[1]

As mentioned in the Introduction, Japan has proposed Society 5.0 as the vision for the future society in its Fifth Science and Technology Basic Plan, and has been making efforts to bring it into reality.

Science and technology have rapidly advanced in recent years, with the emergence of innovative technologies such as AI[2] in the information and communications technology (ICT) field, and genome editing in the biotechnology field. These new technologies are having increasingly greater impact on the economy and society. In addition, the predictability of the future has been declining recently due to changes in international affairs, such as the U.S. and China's trade war for technological supremacy and the U.K.'s withdrawal from the European Union, as well as rapid changes in society as a result of the diversification of people's values and lifestyles.

1 UN Sustainable Development Solutions Network (SDSN),"Getting Started with the SDGs," December 2015
2 Artificial Intelligence

Amidst such increasing diversity and uncertainty of the future, the government is currently holding discussions to formulate the next Science and Technology Basic Plan. In order to respond flexibly to changes and to solve global challenges such as those stipulated as the SDGs and other issues that Japan faces, including the declining birthrate and aging population, it is necessary to design the vision for the future society positively and proactively with science and technology, expanding possibilities and options for the future and leading transformation, by backcasting from the vision for the future society and forecasting based on the current trends in science and technology.

Section 1 About the Prediction of the Future

The Stairway to the 21st Century, compiled by the then Science and Technology Agency in 1960, is one of the most famous predictions of future science and technology in Japan. It was prepared shortly after the establishment of the Science and Technology Agency in 1956, in the midst of a period of rapid economic growth, in order to promote social change by presenting a common dream for the people--a brighter society in the near future made possible by science and technology. The book was written by researchers from universities and other institutions. It offered a vision of what science and technology and society would look like in the 21st century 40 years from then, covering a wide range of fields including energy, computer science, life sciences, disaster prevention, physics, and space.

■Figure 1-1-2/Cover of the Stairway to the 21st Century (Reprint)

Source: KOUBUNDOU Publishers Inc.

In 1971, the then Science and Technology Agency [1] started the Science and Technology Foresight Survey to understand the direction of the medium- to long-term development of science and technology, with a view to contributing to the planning and formulation of science and technology policies and R&D strategies.

In recent years, governments and private companies in Japan and abroad have also made their own predictions of the future using various methods and incorporated them in the development and formulation of administrative plans and management strategies.

This chapter describes typical prediction methods and introduces what our future society may look like according to public and private sector prediction initiatives in science and technology in Japan and abroad.

1 Since the fifth round, the survey has been conducted by the current National Institute of Science and Technology Policy (NISTEP), MEXT.

1 History of Prediction Initiatives

In general, prediction is defined as an a priori estimation of future events or conditions.

In terms of the prediction of the future focused on science and technology, the OECD,[1] which has promoted a technological forecasting initiative to predict trends in science and technology since the 1970s, defines the term "forecast" as "a probabilistic statement on a relatively high confidence level, about the future" and technological forecasting as "the probabilistic assessment, on a relatively high confidence level, of future technology transfer."[2] The purpose of technological forecasting is to predict the development of scientific and technological seeds, i.e., what kind of technology will be realized in what year, on an exploratory basis.

Since the latter half of the 1990s, amidst the high expectations for science and technology to contribute to resolving social issues, "foresight"[3][4] has come to be used as a means to predict a desirable future society and determine the required state of science and technology to achieve it (see Figure 1-1-3).

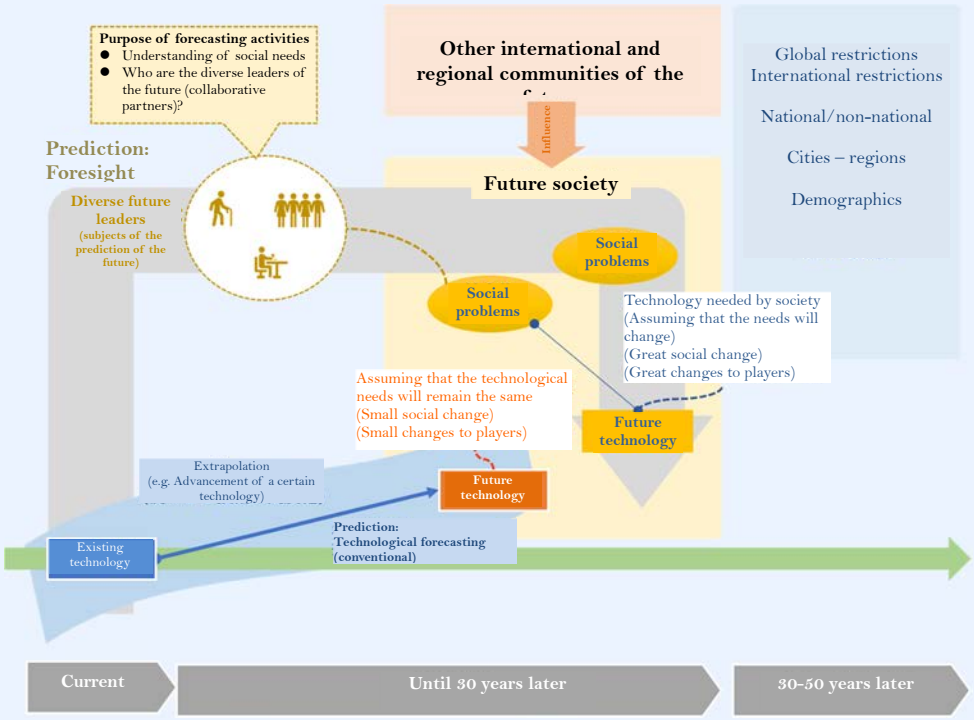
With these changes in the purpose of prediction, entities involved in prediction have also changed. In addition to the understanding of the latest trends in science and technology, it has become necessary to understand the changes in society and its needs. For this reason, it has become necessary to involve a highly diverse group of people, such as those who will lead future society, rather than predicting the future solely with a homogeneous group of researchers and engineers. In terms of method, backcasting based on a vision of a desirable future has come to be used in addition to forecasting, which is based on the current scientific and technological trends.

For these reasons, European and other countries are shifting from future predictions solely focused on science and technology to ones that also look to future society by means such as workshops (a participatory consensus building process), which involve a variety of stakeholders. Such approach to prediction for policy formation is often aimed at building consensus among stakeholders for the future society, rather than improving the accuracy of the prediction (whether the prediction is realized or not).

Private companies are also expanding their scope of prediction to include future social changes that their businesses will have to cope with and possible future business partners, in addition to conventional technological forecasting for R&D planning.

1 Organisation for Economic Co-operation and Development
2 OECD (1976), Technological Forecasting.
3 Foresight generally means consideration and prudence for the future, forecast and insight (Source: Progressive English-Japanese-Chinese Dictionary, Shogakukan). In the context of the prediction of the future, it is often translated as "miraidousatsu (future insight)" in Japanese.
4 The international foresight expert group Technology Futures Analysis Method Working Group defines "foresight" as "a systematic process to identify future technology developments and their interactions with society and the environment for the purpose of guiding actions designed to produce a more desirable future." Technology futures analysis: Toward integration of the field and new methods, Technological Forecasting & Social Change, vol.21, pp.287-303 (2004).

Figure 1-1-3/Changes in prediction in science and technology



Source: MEXT

2 Prediction Methods

A variety of prediction methods have been developed for different subjects and purposes. Table 1-1-4 shows examples of quantitative and qualitative forecasting methods and their characteristics.

■Table 1-1-4/Overview of major forecasting methods

Method	Outline
Simulation (Quantitative method)	The simulation method is a method of predicting future situations by extracting and modeling characteristic elements from real subjects and phenomena, and then simulating them with computers and other devices. Improvements in computer performance have made it possible to predict complex events. In 1972, the Club of Rome published the Limits to Growth, which shocked the world with its warning about the future of humanity that "if the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years."
Delphi method (Quantitative method)	The Delphi method is a method of convergence of opinion. With this method, a group of experts is asked the same question multiple times, with the results from the previous survey presented each time. It can be said to be a consensus building means in the sense that it is aimed at the convergence of opinions of a group of people. This method was developed by the RAND Corporation in the 1950s and has been used for defense planning and other purposes in the United States. In Japan, the then Science and Technology Agency (currently the NISTEP, MEXT) started the Science and Technology Foresight Survey using the Delphi method in 1971, which predicts technological trends for the next 30 years.
Scenario planning (Qualitative method)	This method envisages multiple possible outcomes and describes the processes leading up to them, with branching factors that can have a great impact on the uncertain future, such as the natural environment, social and political developments, scientific discoveries, and technological innovations. It enables fast decision-making in the event of rapid social change. Since the early 1970s, Royal Dutch Shell, the world's leading energy company, has been developing long-term energy future scenarios and using them to plan its business strategies. The company drew attention as it presented a scenario of high oil prices before the oil crisis erupted.
Scanning method (Qualitative method)	With the scanning method, early signs of change that can have a great impact on the future are determined by surveying publications, websites, interviews with experts and other currently available information sources. The impacts of these signs are analyzed from various perspectives (social, technological, environmental, policy, ethical, etc.). It becomes possible to make predictions that incorporate a wide range of impacts by focusing on minute changes in society. In the UK, the National Horizon Scanning Centre (NHSC) was established under the Government Office for Science in 2004. Since then, government agencies in other countries and international organizations such as the OECD and the EU[1] have also used this method.
Visioning (Qualitative method)	With the visioning method, a discussion is held with the participation of diverse stakeholders to understand the current situation and challenges, explore ideas for a desirable future, and share long-term goals and strategic objectives. It can be used as a method of backcasting by also examining ways to achieve the desirable future. In recent years, many of the Japanese government's prediction initiatives have adopted this method, including the Science and Technology Foresight by the NISTEP, MEXT.

Source: MEXT

It is common to use a combination of multiple methods from the above to predict the future, keeping in

1 European Union

mind the characteristics of individual methods.

Section 2 Public and Private Sector Prediction Initiatives in Japan and Abroad

Since the prediction of the future is closely related to the formulation of government and company plans and strategies, the details of such initiatives are often undisclosed. This section introduces some domestic and international public and private sector prediction (foresight) initiatives in science and technology that uses a backcasting approach, whose methodology and envisioned future society have been made publicly available.

1 Government Initiatives in Japan

(1) "S&T Foresight Survey," NISTEP, MEXT

With the aim of contributing to discussions for planning and formulating science, technology and innovation policies and R&D strategies, the National Institute of Science and Technology Policy (NISTEP), MEXT, has conducted the Science and Technology (S&T) Foresight Survey approximately every five years since 1971 to identify the direction of medium- to long-term development of science and technology.

Since the 8th Survey, the survey—which had first solely adopted a forecasting approach that considers future society based on science and technology development (technology foresight)—has also come to use a backcasting approach that identifies science and technology required for realizing a desired society. The survey has continuously attempted to derive a desirable society and extract science and technology that will contribute to realizing such society by combining multiple techniques, such as the Delphi method, scenario planning, and visioning, and has constantly led the world in this area. The 11th Survey, published in November 2019, clarified the four values that should be emphasized in Japan's future society—Humanity (changing ways of life), Inclusion (not leaving anyone behind), Sustainability (sustainable Japan), and Curiosity (eternal curiosity)—and "a flexible society brought about by reviving and rethinking humanity" as a desirable society in 2040. The 11th Survey will be discussed in detail in Chapter 2.

(2) "TECH Strategy to Grab the Future," MIC

In August 2018, the Subcommittee for Making the Future of the IoT[1] New Era, Information and Communications Policy Committee, Telecommunications Council, Ministry of Internal Affairs and Communications (MIC), formulated the TECH Strategy to Grab the Future. With structural changes due to the declining population, low birthrate and aging population in mind, the Strategy describes realistic assumptions, constraints, and other conditions and explores new goals for the next-generation society--a society that taps into the rich potential of information and communication technology (ICT). Backcasting from this vision of a desirable future in the 2030s, it presents a reform plan for achieving change through aggressive ICT implementation.

There are three pillars for the desirable future for the 2030s, namely, "human," "community" and "industrial" development as described below.

Human development: An "inclusive" society where everyone can enjoy a rich life with diverse values and

1 Internet of Things

lifestyles regardless of age, gender, disability, nationality, income, etc.

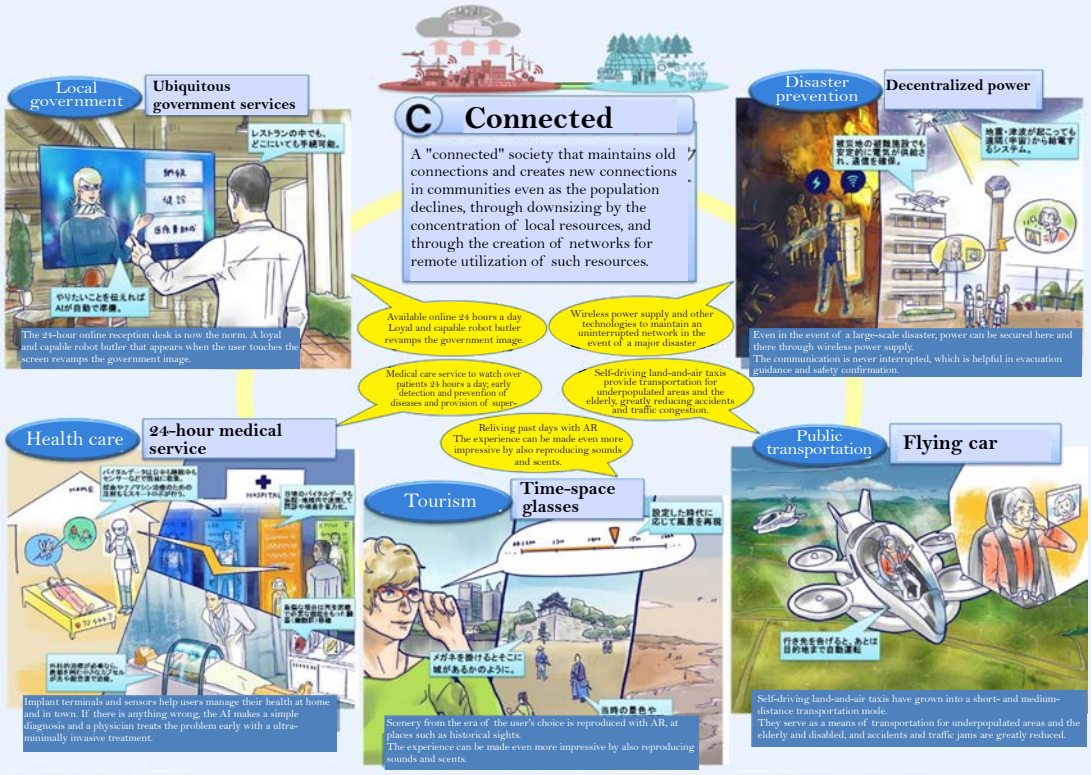
Community development: A "connected" society that maintains old connections and creates new connections in communities even as the population declines, through downsizing by the concentration of local resources, and through the creation of networks for remote utilization of such resources.

Industrial development: A "transforming" society that develops in response to technological innovation and changes in the market environment through a flexible and responsive approach that assumes design changes.

The Strategy backcasts from this vision of a desirable future and examines and proposes the nature of the information and communications policies that need to be implemented over the next few years.

In addition, the Strategy provides illustrations of 15 exemplary scenes showing how technology shapes a new society from the perspectives of human, community and industrial development.

■Figure 1-1-5/The future Japan aspires to achieve in the 2030s (Community Development) "C: Connected"



Source: MIC

(3) "Future Innovations Working Group," METI/MHLW

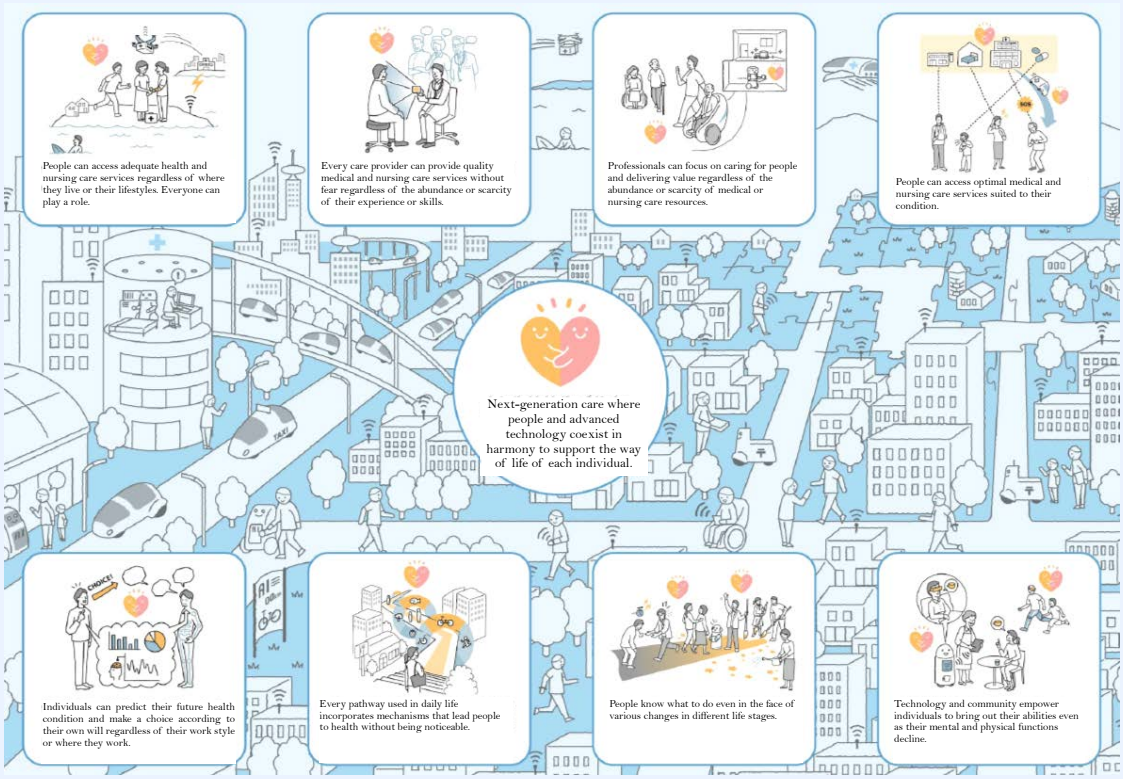
The Ministry of Economy, Trade and Industry (METI) and the Ministry of Health, Labour and Welfare (MHLW) established the Future Innovations Working Group under three councils: the Next-Generation Healthcare Industrial Council; the Council for Promotion of the Next-Generation Medical Equipment Development; and the Next-Generation Medical ICT Council. Its purpose is to discuss the desirable future of the medical and welfare field in 2040, in which humans and advanced technologies will coexist in

harmony, keeping in mind the progress of reforms in this field happening as a result of the fourth industrial revolution, which includes the rise of IoT, AI and robotics technologies.

When considering the future of the medical and welfare field around 2040, it is necessary to consider not only the gradual improvement of the technologies introduced today, but also the expected future social and regional changes and technological innovations. In this view, the Working Group released in March 2019 A Message from the Future Innovations Working Group: Towards the Realization of Next-Generation Care Supporting the Lifestyle of Each Individual Through the Symbiosis of Humans and Advanced Technologies, which summarizes medium- to long-term measures that are backcast from the vision of the desirable future in the fields of health, medical and nursing care.

This message was utilized in the discussion of the goals for 2050 under the Moonshot R&D Program (see Chapter 3, Section 2).

■Figure 1-1-6/Vision of health, medical and nursing care in the society of 2040 in which advanced technologies are integrated



Source: METI/MHLW

2 European Commission and Private Sector Initiatives

(1) "BOHEMIA Project," Directorate General for Research and Innovation, European Commission

In order to identify priorities in Horizon Europe, a planned research and innovation framework program for 2021-2027, the European Commission's Directorate General for Research and Innovation carried out the BOHEMIA project[1] to forecast the shape of the future society in 2040 and recommend the research and innovation needed for it. In March 2018, the final report Perspectives for the European Union's Future Research and Innovation Policies[2] was released.

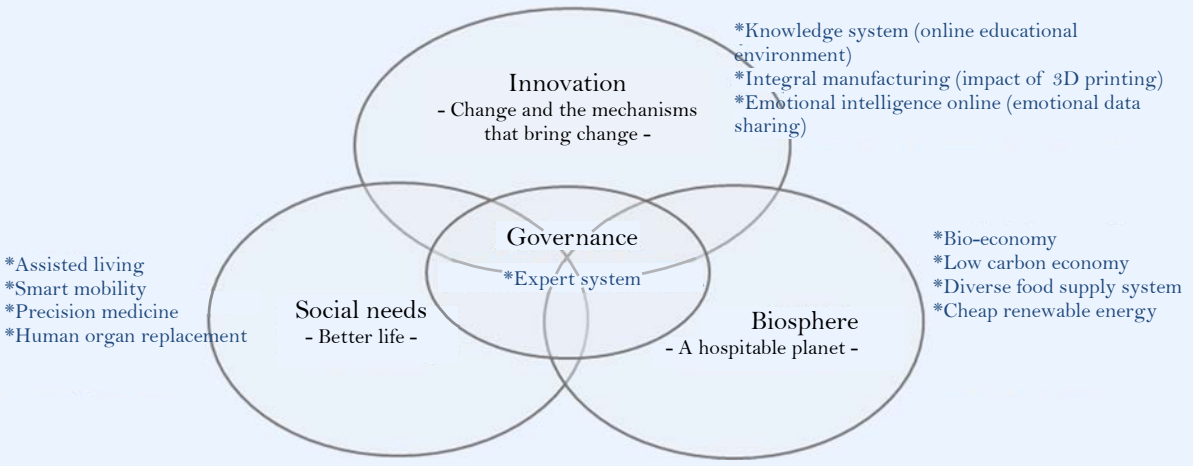
The report concluded that, if the EU is to maintain its strong economic and political role in the world and enable Europeans to co-shape the future they want, the EU's research and innovation policies need to simultaneously promote the following four transitions towards the achievement of the SDGs.

- Social Needs: Providing for the needs of people
- The Biosphere: Safeguarding a hospitable planet
- Innovation: Harnessing the forces of change
- Governance: Joining forces for a better world

The report also emphasized the importance of prioritizing research and innovation related to these four transitions. It lays out 19 scenarios[3] that are most likely to be realized in the future and identified the directions of the highest priority R&D projects for realizing these scenarios.

Horizon Europe will be developed based on these directions.

■Figure 1-1-7/The four transitions and scenarios



Source: MEXT, based on the Perspectives for the European Union's Future Research and Innovation Policies

(2) "The Sky Scenario," Royal Dutch Shell

Royal Dutch Shell, a global energy and petrochemicals group, has been developing and releasing a series

1 Beyond the Horizon: foresight in support of future EU research and innovation policy (BOHEMIA)
2 Transitions on the Horizon:Perspectives for the European Union's future research and innovation policies
3 The target scenarios are "Assisted Living," "The Bio-economy," "Cheap Renewable Energy," "Continuous Cyberwar," "Ubiquitous Expert Systems" (big data and artificial intelligence to assist in decision making), "Defeating Communicable Diseases," "Emotional Intelligence Online" (emotional data sharing), "Human Organ Replacement," "ICT-Based Security and Defense," "Low Carbon Economy," "Material Resource Efficiency," "Nano-to-Macro Integral Manufacturing" (3D printing), "Nature Valued," "Precision Medicine," "Reframing Work," "Smart Sustainable Mobility," "The Electro sphere of Sensors" (real-time scanning of society with sensors), "Towards a More Diverse Food Supply System," and "Towards a New Knowledge System" (online educational environment).

of scenarios for the future of energy since the early 1970s.[1]

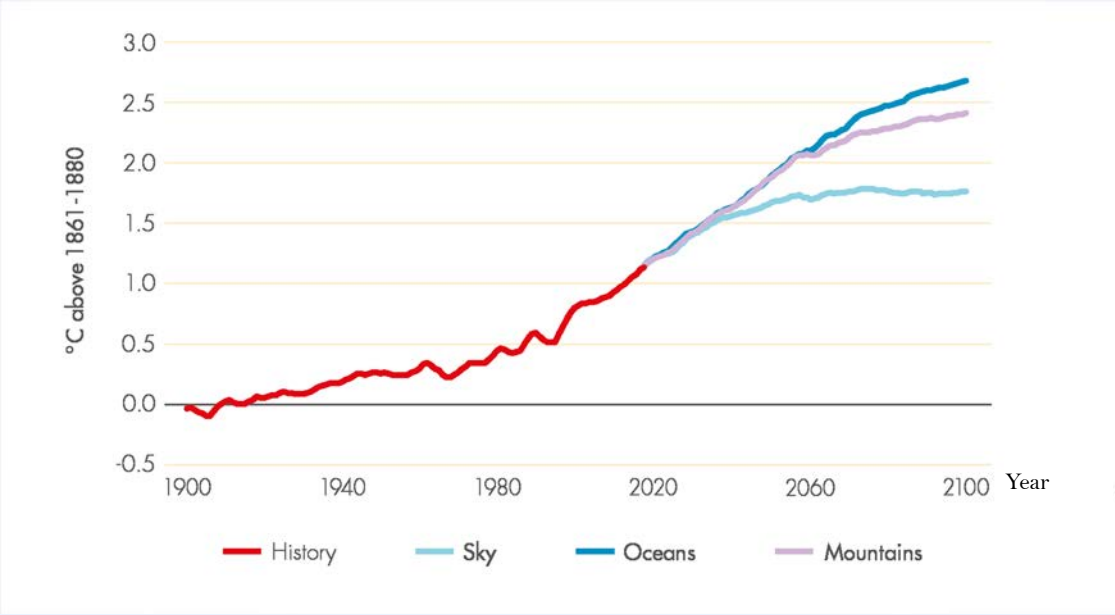
The Sky Scenario,[2] published in March 2018, lays out the path to achieving the goals of the Paris Agreement, a challenging scenario that analyzes the changes needed to keep the average global temperature increase since the period before the industrial revolution well below 2°C. It points out that in order to achieve net zero emissions of carbon dioxide (CO_2) by 2070, civil society, businesses, and governments will need to complement each other to accelerate their efforts. It then lays out a challenging but achievable technological, economic, and industrial pathways. The following are the main features of the scenario.

- Legislation for the rapid reduction of CO_2 emissions by 2030 at the national level, in particular an effective carbon pricing system is needed
- Progress in electrification. Electricity will exceed 50% of final energy consumption (five times more than in 2017), and solar power will be the dominant power to be generated. Along with CO_2 capture and storage technology, biomass power generation, which provides a carbon sink, becomes commonplace.
- As for automobiles, the phasing out of internal combustion engines will lead to the electrification of transportation systems. (By 2035, all new passenger cars sold in OECD and China will be electric, and by 2050 this trend will expand globally. In the longer term, biofuels and hydrogen will also play an important role).
- As for fossil fuels, demand for petroleum will begin to decline by the 2030s, but will be maintained at around 50 million barrels per day, mainly for long-distance transportation and the chemical industry, while combined use with biofuels and other fuels will be promoted.
- Demand for natural gas will grow until the mid-2020s as a complementary energy during the transition to renewable energy, before it begins to gradually decline after 2040.

1 The scenario planning department envisions several future societies simultaneously, drawing on insights from internal and external experts in various fields. It is an analysis of the external environment that is independent of the company's business strategy and business plan.

2 https://www.shell.com/promos/business-customers-promos/download-latest-scenario-sky/_jcr_content.stream/1530643931055/eca19f7fc0d20adbe830d3b0b27bcc9ef72198f5/shell-scenario-sky.pdf
The Sky Scenario was created in addition to two different future scenarios for the year 2060, the "Mountain" and "Ocean" scenarios, presented in the New Lens Scenarios released in March 2013. In the Mountain scenario, those with vested interests (the mountaintop) seek to create social stability by maintaining the current system, and the presence of natural gas, nuclear power, and CO_2 capture and storage technologies will increase. In the Ocean scenario, people power takes center stage and adjustment by the market principle plays a major role. After a long era of oil and coal, solar power will become the dominant energy source worldwide.

■Figure 1-1-8/Comparison of global average temperature rise in different scenarios



Source: Royal Dutch Shell

(3) "Vision Design," Hitachi, Ltd.

Hitachi, Ltd., a general electronics manufacturer, is implementing "Vision Design,"[1] an activity to envision the future, as part of its efforts to promote its social innovation business, led by its Vision Design Project, Global Center for Social Innovation. The project team presents a vision scenario of what the future social system should be like and carries out activities to stimulate discussion among stakeholders. The project focuses on showing the direction of changes in consumer values and discussing possible ways to deal with problems that new technologies may unintentionally bring to people and ways in which technology can be made not only convenient and efficient, but also more accessible to people.

Using the future insight tool Kizashi, which summarizes the perspectives of future changes based on PEST (Politics, Economy, Society, Technology) analysis, vision scenarios are created for multiple domains, including urban development, homes, automated driving, and energy. The core parts of some of these scenarios are now being put to practical use for social demonstrations. In recent years, the project has focused on the "future of trust" and developed three scenarios for the future social system from the perspective of trust: "one-on-one trust with high transparency", "trust in centralized management by large corporations", and "trust of autonomous and decentralized communities".

The Hitachi-Kyodai Lab, a joint project with Kyoto University, has also taken the Vision Design activities to the next level. In relation to the study topic titled "Universities and Corporations in 2050," the Hitachi Kyodai Lab has been holding discussions with researchers in the fields of primatology, symbiotic anthropology, economics, Southeast Asian studies, psychology and well-being, ancient Roman history, and African area studies to identify the social issues that universities and businesses will face in the future. Based on the social challenges extracted from these discussions, the Lab describes a dystopia in which people are experiencing three losses--"Nothing to believe in" "Nothing to rely on" and "Nothing to do"--and shows

1 https://www.hitachi.co.jp/rd/portal/highlight/vision_design/index.html

ways to prevent these. In the AI-derived Social Concepts and Policy Recommendations project, experts in the humanities and social sciences and researchers in the information sciences jointly made policy recommendations for a sustainable Japanese future based on AI-derived future scenarios for Japan (the ideal society).[1]

■Figure 1-1-9/Examples of the Vision Scenarios

Source: Hitachi, Ltd.

(4) "Future Society 2050," Mitsubishi Research Institute, Inc.

In October 2019, Mitsubishi Research Institute, Inc. published the Future Society 2050 based on its estimates of emerging social issues and trends, as well as long-term statistical data, through a literature survey and discussions with experts.

The report states that the world in 2050 should be an "affluent and sustainable world" (the term "affluent" here refers not only to economic wealth, but also to general satisfaction about relationships, work, health, and other aspects of life). In order to achieve this, countries around the world need to share and observe common values, morals, and social norms, including respect for basic human rights, the rule of law, respect for privacy, and the importance of sustainability. The report also predicts that the world economy will become more multipolar by 2050, and unless an "affluent and sustainable world" is achieved, the world will become more divided and it will be difficult to form an international consensus on measures to combat climate change and other issues.

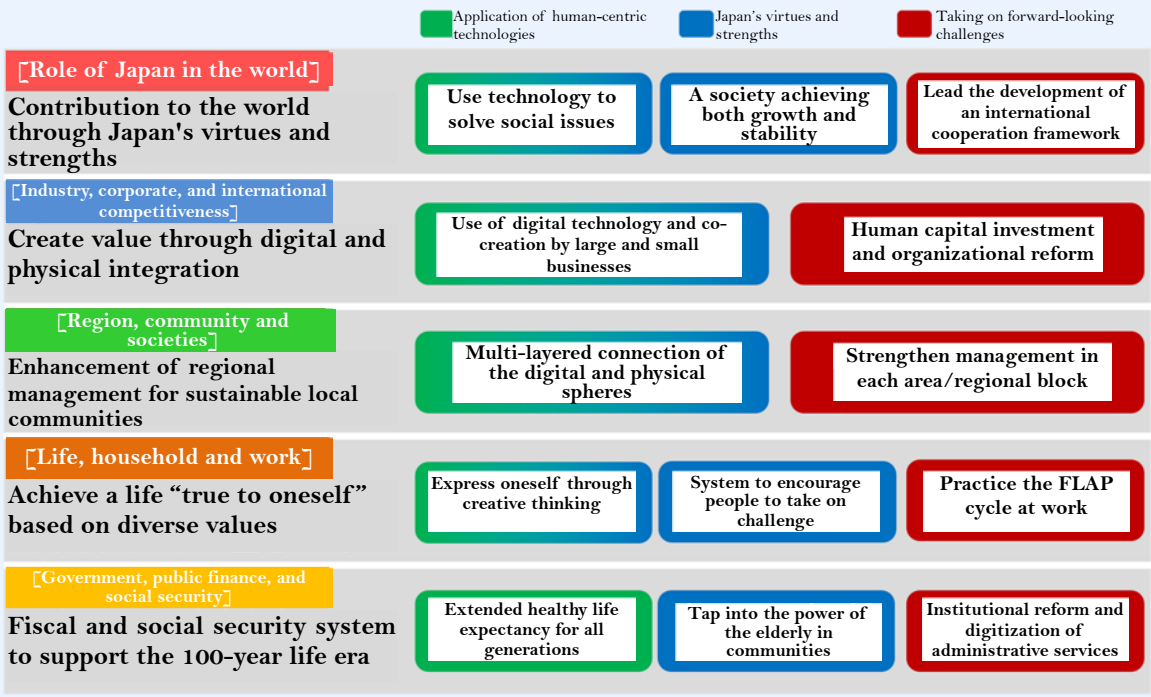
The report lists the following six global trends that must be kept in mind in the pursuit of the desirable world: (1) the emergence of the digital and platform economy, (2) international order without hegemony, (3) a circular economy with less carbon emissions, (4) changing role of government, (5) society containing diverse communities, and (6) changing life through new technologies.

The report argued that in order for the Japanese economy, society, and individuals to enhance their vitality, they must seize changing global trends as an opportunity to solve social problems and realize a more affluent lifestyle, rather than be passively influenced by them. This calls for the government,

1 See Column 1-2 for the use of AI in the collaborative project with the MEXT concerning higher education policy.

companies, and individuals to proactively utilize human-centered technologies, demonstrate Japan's virtues and strengths, and take on forward-looking challenges.

■Figure 1-1-10/Three types of actions needed to achieve an affluent and sustainable society



Source: Mitsubishi Research Institute, Inc.

*FLAP cycle, coined by Mitsubishi Research Institute, refers to a cycle in which an individual learns about his/her aptitude and professional requirements (Find), learns the necessary knowledge to improve his/her skills (Learn), takes action in the direction he/she wants to take (Act), and takes an active part in a new stage (Perform).

(5) "Japan In 2050: Overcoming Challenges And Continuing To Shine," Mizuho Financial Group

In December 2017, Mizuho Financial Group, Inc. released a report titled "Japan in 2050: Overcoming Challenges and Continuing to Shine," which explores how Japan can overcome major changes, including the declining and aging population and technological advances known as the fourth industrial revolution, as well as what its ultra-long-term vision should be like (the desirable future), providing a guidepost for addressing structural challenges.

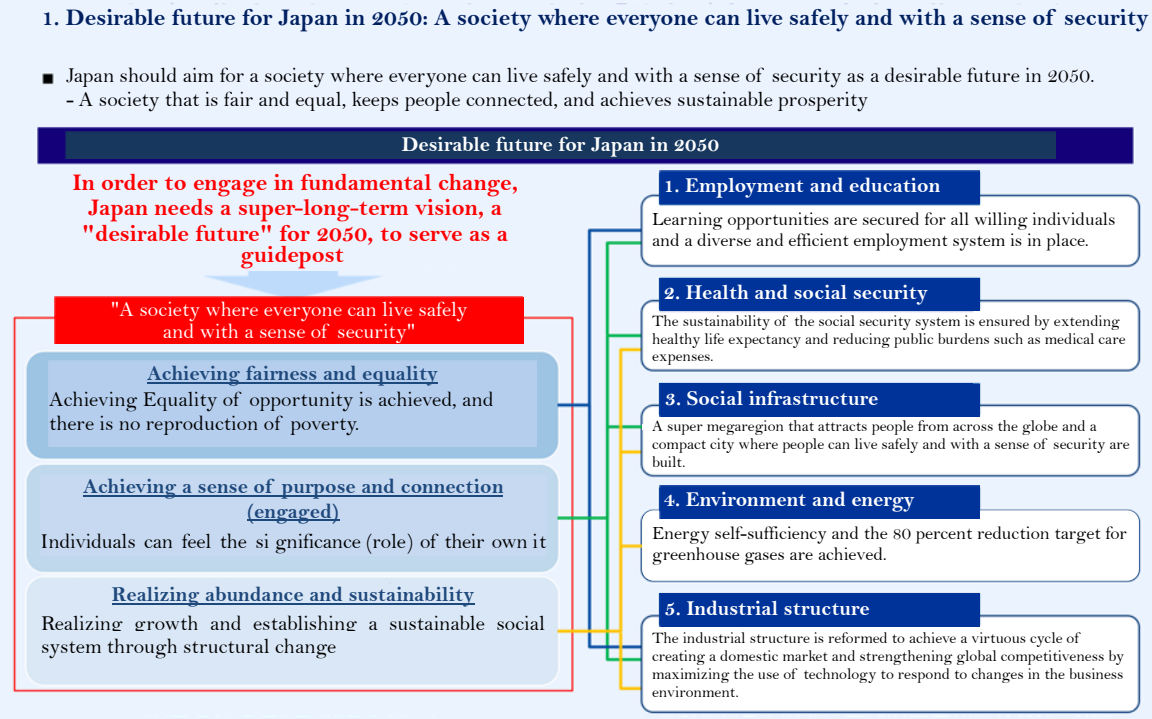
Forecasting global economic and technological trends surrounding Japan in 2050, the report states that the global economy will expand mainly in Asia, and that the evolution of technology will cause discontinuous changes in various fields, which will have a major impact on the economy and society.

The report lays out two major issues that Japan must address by 2050, which are (1) reforming its institutions and systems to adapt to the declining and aging population and (2) reviewing regulations and systems to harmonize advanced technology with society and the economy. If these measures are not taken, serious problems will arise in various areas, negative growth will become the norm, and the economic and social infrastructure will be damaged, leading Japan to become an "insecure and unsafe society."

The report argues that in order to avoid a dire future, drastic changes, rather than symptomatic treatment for individual problems, are essential. It is necessary to draw up a desirable future for 2050 and look in the

right direction. To achieve such desirable future, it is necessary to address issues and make efforts in areas such as employment and education, medical care and social security, social infrastructure, environment and energy, and industrial structure. The report concludes that this will enable Japan to achieve sustainable growth, be highly competitive globally, and demonstrate its presence with its technology and knowledge.

■Figure 1-1-11/Desirable future for Japan in 2050



Source: Mizuho Financial Group, Inc.
(Cited from "Japan In 2050: Overcoming Challenges And Continuing To Shine," Industry Research Division, Muzuho Bank)

(6) Other Corporate Initiatives

In addition to the above, companies are promoting the following initiatives that contribute to management strategy development:

- Developing services from the perspective of consumers in 2030 and beyond, rather than based on technologies
- Providing an open space where people inside and outside of the company can predict the future together.
- Providing a chronological prediction database created from publicly available data.

3 Summary

Looking over different predictions, the following can be listed as the common features of the future societies that these predictions envision keeping in mind digitalization and response to global challenges.

- Extension of healthy life expectancy by improving medical and health care services
- Diversification of lifestyles through expansion of activities in virtual spaces
- Progress of industrial automation and unmanned operation and creation of new industries such as

data and service industries by advancements in AI, robots, and other ICT

- Transition to a sustainable society through decarbonization and progress in resource recycling

Particularly, many forecasts from Japan predict a society that can achieve (i) sustainable development through the maximized utilization of ICT as a tool to cope with the declining birthrate and aging population, (ii) personalized medical and nursing care, (iii) respect for individuality (i.e. diversity and inclusion), and (iv) inter-regional cooperation.

In the next chapter, the future 20 years from now is predicted based on the Science and Technology Foresight Study conducted by the NISTEP, MEXT, describing a future society expanded by science and technology (Society 5.0).

Column 1-2

A Simulation of the Future of Japanese Society Using Artificial Intelligence

Attempts to use AI to predict a future society, present options, and analyze policies for a desirable society have begun.

A group led by Professor Yoshinori Hiroi of Kyoto University's Kokoro Research Center and the Hitachi-Kyodai Lab have analyzed measures to ensure the sustainability of Japanese society towards 2050 using AI, and published the results in September 2017 under the title of the AI-Derived Policy Proposal for a Sustainable Future of Japan. The study identified 149 social factors (e.g. demographics, aging population, GDP, etc.) considered important for the future of Japanese society, created a cause-and-effect model, used AI to make about 20,000 predictions, and evaluated them in terms of sustainability in four key areas, namely, (1) population, (2) public finance/social security, (3) cities/regions, and (4) environment/resources, and from the perspectives of four factors, namely, employment, inequality, health, and well-being, while also examining policies toward a desirable society.[1]

In addition, the MEXT and the above-mentioned research team collaborated on AI simulations of the future of Japanese society and higher education. The results showed that the quality improvement and enhancement of higher education has a high degree of contribution to the sustainability and social performance of Japanese society, and that the desirable improvement and strengthening of higher education will lead to the balanced development of individual regions in Japan and the nation as a whole. The results were reported to the Joint Meeting of the Universities Subcommittee and the Future Plan Subcommittee of the Central Council for Education in November 2018, and also were published as a reference material for the Grand Design for Higher Education Towards 2040 (Report of Central Council for Education in November 2018).[2]

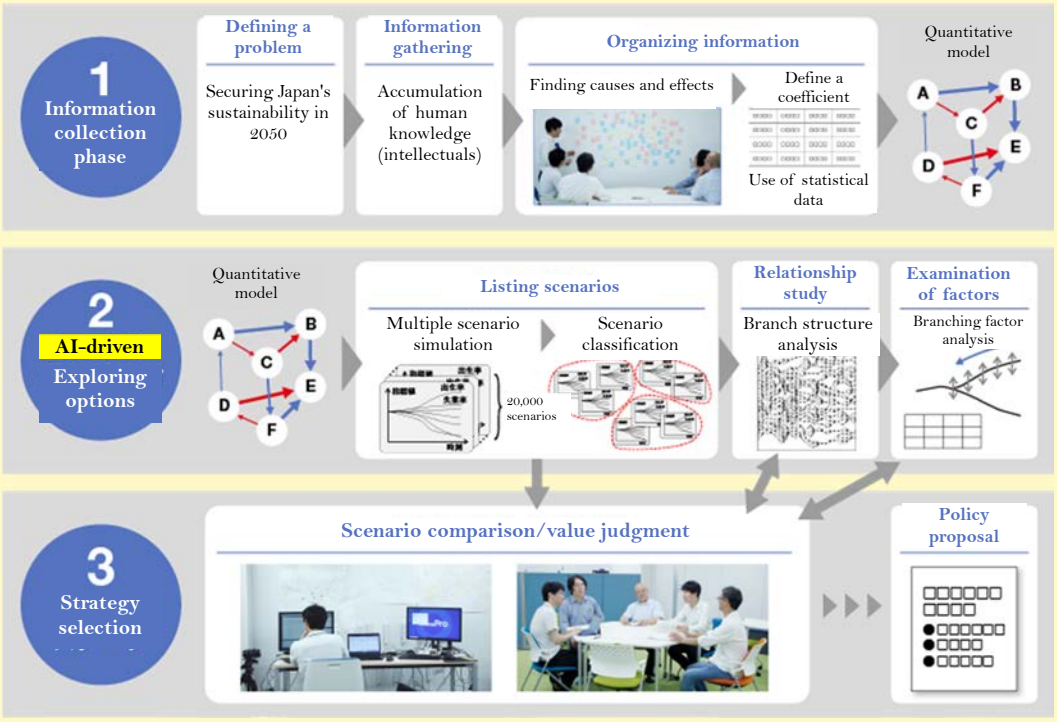
Simulations using AI have the following advantages: (1) the ability to correct human cognitive distortions and biases by comprehensively enumerating a myriad of future possibilities and scenarios, (2) the ability to analyze complex relationships and influences among many factors, and (3) the ability to make predictions that incorporate uncertainties and ambiguities. On the other hand, there are also some challenges, such as the development of a more sophisticated methodology and the improvement of accuracy.

<Reference URL>

1 https://www.hitachi.co.jp/New/cnews/month/2017/09/0905.html

2 https://www.mext.go.jp/b_menu/shingi/chukyo/chukyo0/toushin/1411360.htm

Overview of the Policy Proposal Process



Source: Hitachi, Ltd.

Column 1-3

Teenagers Chart the Future of a Company

An initiative has been launched to change the trends of existing prediction activities, which are mostly carried out solely by adults from the government, companies and research institutions, and involve youths who are to be living that discussed future in the process of discussing a desirable.

In October 2019, a 17-year-old high school student was appointed CFO of Euglena Co., Ltd., a domestic venture company whose business is based on the R&D of the microalgae Euglena. Her title CFO does not stand for Chief Financial Officer; it stands for Chief Future Officer. The CFO's role has to do with "everything that will change the company and its future." She manages meetings for planning actions and setting targets concerning Euglena's SDGs toward 2030. Nine teenagers (ages 12-18), including the CFO herself, join the meetings and formulate proposals for Euglena, tapping into their youthful sensibilities.

Euglena Co., Ltd. launched this initiative after realizing that its existing internal system alone was not enough through their past activities of meeting with children to discuss the future of the Earth. Believing that when decisions are made about the future that the people who will be living that future should be involved in the discussion, the company invited applications from young people under the age of 18 for the position of CFO. The only requirement was that applicants had to be 18 years old or younger. They were screened and interviewed based on a questionnaire that asked them which of the 17 SDGs they were interested in and what they wanted to do to achieve those goals at the company.

Euglena Co., Ltd. believes that having a teenager CFO is valuable in itself, similar to investing in new technologies in the hopes of creating innovation. Although the company's management is in their 30s as of 2020, they still tend to make somewhat short-sighted decisions. The company intends to continue its CFO initiative to listen to the opinions of those who will lead the future.

The CFO (center) and the teens

Discussion of proposals

Source: Euglena Co., Ltd.

Column 1-4

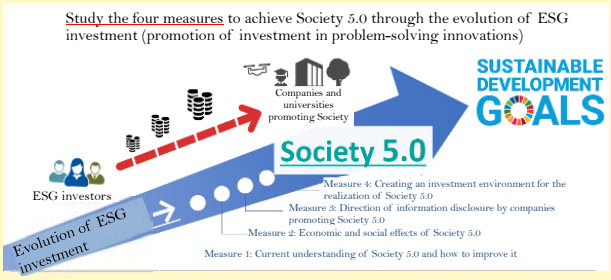
Evolution of ESG Investments to Achieve Society 5.0 for SDGs

Keidanren (Japan Business Federation), the University of Tokyo, and the Government Pension Investment Fund (GPIF) have been conducting a joint study on Society 5.0 for SDGs since June 2019 and released a report in March 2020. As the background of the joint research, the following four major social changes were cited.

1. Progress in digital innovation	Advances in digital technology have enabled not only digital devices but also all kinds of "things" to be connected to the Internet. In addition, the sophistication of AI technology, which can predict, analyze and optimize information, and the social implementation of 5G communication technology, which connects various technologies, are just around the corner.
2. Changes in the economic and social structure	Demographic changes due to the declining birthrate and aging population are a common challenge for countries around the world. The center of the global economy is shifting further toward Asia and other emerging economies. There are concerns about the prolonged period of low growth and low interest rates in Japan, Europe, and other advanced economies.
3. A growing sense of urgency about global environmental issues	The significance of environmental issues as a global risk has become extremely high. In addition, climate change is a global challenge. The creation of business-led, discontinuous innovation is essential to solve it and the market for the environment (which is what the E of ESG investment[1] stands for) is growing significantly.
4. Changing people's mindset	It is said that in the next five years, about half of all consumers and workers will be millennials, who are not only interested in economic growth but also in contributing to society, and the digital native generation, who have been surrounded by digital devices since they can remember.

The realization of Society 5.0 for SDGs, a concept that originated in Japan, is the key to seizing these major changes as an opportunity to build a sustainable, human-centered society and achieve medium- to long-term economic growth.

The report states that in order to realize Society 5.0 for SDGs, it is essential that stable medium- to long-term funding is directed to a diverse range of entities leading problem-solving innovations, including companies and universities, and that the innovation ecosystem evolves autonomously. The report argues that Japan should seize and evolve the ESG investment movement (promoting investment in problem-solving innovations) to achieve Society 5.0 and quickly and reliably achieve the SDGs. Keidanren, the University of Tokyo, and the GPIF examined the following four measures to achieve this goal and presented an action plan.



Purpose and overview of the report

Measure 1: Current understanding of Society 5.0 and how to improve it	Present specific measures to improve understanding of Society 5.0.
Measure 2: Economic and social effects of Society 5.0	Estimate economic and social effects of the realization of Society 5.0, including growth opportunities in key industry sectors. Present the benefits.
Measure 3: Direction of information disclosure by companies promoting Society 5.0	Explore the direction of information disclosure to increase investment in companies promoting Society 5.0, and present the key points of information disclosure, such as the fact that a long-term vision that includes elements of people-driven business development, resolution of global issues, and creation of new markets will be highly valued by investors.
Measure 4: Creating an investment environment for the realization of Society 5.0	Organize the roles of each entity and present specific proposals for promoting investment in universities and startups in order to create an investment environment for the realization of Society 5.0.

<Reference URL> Full report
https://www.u-tokyo.ac.jp/content/400137089.pdf

1 Investments that take into account not only conventional financial information, but also environmental, social and governance factors.