

Comprehensive Strategy on Science, Technology and Innovation

- A Challenge for Creating Japan in a New Dimension -

June 7, 2013

Cabinet Decision

This provisional translation is subject to
change for the sake of greater accuracy.

Table of Contents

<u>Chapter 1 Toward Establishing a Nation on Science, Technology and Innovation</u>	1
I. Formulating the Comprehensive Strategy on Science, Technology and Innovation	1
1. Need for formulating the Comprehensive Strategy on Science, Technology and Innovation	1
2. Basic concepts of the Comprehensive Strategy on Science, Technology and Innovation	4
II. Future of Japan created through science, technology and innovation – long-term vision	7
1. Shapes of the nation to be attained in 2030	7
2. Creating an environment that facilitates science, technology and innovation	8
3. Immediate priority policy issues for realization of the ideal economic society	9
4. Three perspectives for promoting the science, technology and innovation policies	12
<u>Chapter 2 Challenges to Be Addressed by Science, Technology and Innovation</u>	14
I. Realization of a clean and economic energy system	14
1. Basic understanding	14
2. Focused policy challenges	15
3. Focused measures	17
II. Realization of healthy and active ageing society as a top-runner in the world	24
1. Basic understanding	24
2. Focused policy challenges	24
3. Focused measures	27
III. Development of next generation infrastructures as a top-runner in the world	34
1. Basic understanding	34
2. Focused policy challenges	35
3. Focused Measures	36
IV. Regional revitalization taking advantage of the regional resources	39
1. Basic understanding	39
2. Focused policy challenges	39
3. Focused measures	41
V. Early Recovery and Revitalization from the Great East Japan Earthquake	46
1. Basic understanding	46
2. Focused policy challenges	46
3. Focused measures	47

<u>Chapter 3</u>	<u>Creating Environment Suited for Science, Technology and Innovation</u>	53
1.	Basic understanding	53
2.	Focused policy challenges	54
3.	Focused measures	54
4.	Main targets to be achieved by 2030	67
5.	Toward establishing “the most innovation-friendly country”	68
<u>Chapter 4</u>	<u>Reinforcing Headquarter Functions of the Council for Science and Technology Policy</u>	70
1.	Basic understanding	70
2.	Immediate actions required for reinforcing headquarter function of the Council for Science and Technology Policy (CSTP)	71

CHAPTER 1 TOWARD ESTABLISHING A NATION ON SCIENCE, TECHNOLOGY AND INNOVATION

I. FORMULATING THE COMPREHENSIVE STRATEGY ON SCIENCE, TECHNOLOGY AND INNOVATION

1. NEED FOR FORMULATING THE COMPREHENSIVE STRATEGY ON SCIENCE, TECHNOLOGY AND INNOVATION

(1) Japan at a Crossroad for the Future

Japan has long enjoyed high economic growth, improvement in the quality of life, and a peaceful and stable society after the war. Japan's rapid development has been highly praised as a rare case in the world and considered as a model for emerging countries. However, today, Japan's medium- to long-term economic and social environment has turned dire, and a sense of stagnation and uncertainty about the future are gradually spreading throughout the nation.

The potential of Japan's economic growth is receding while we see the progress of population decline, declining birthrate and aging population at speed that has never been seen in any other country. Such recession is especially prominent in the regional economy. Lately, globalization of economy has progressed in a short period of time, allowing some countries to rapidly emerge and gain power. However, maturation of Japan's economy has resulted in changes in its industrial structures, rendering Japan unable to take advantage of the dynamism of economic globalization. As a result, Japan's position in the world is getting lower in various aspects including industrial competitiveness, and Japan's presence in the world is getting smaller. As global challenges such as aggravating problems related to environment or energy are becoming critical, high expectation is placed on Japan's technology whereas energy constraints may become a hindrance to Japan's growth. Furthermore, new economic burdens have now emerged: infrastructures established during the high economic growth era now all require renovation, and the national healthcare costs are rapidly increasing as population aging and lower birthrate progress.

Due to such economic hardship, Japan's financial conditions are getting worse and its financial capacity to carry out political measures is receding. At this rate, the sustainability may become questionable. And among others, what is most urgent now is to recover from the Great East Japan Earthquake as early as possible and to be prepared for future large-scale natural disasters. All these problems overhang the nation, further enhancing uncertainty in maintaining and improving the quality of life, and a sense of insecurity and stagnation has risen among the people.

Can Japan pass growth and prosperity of the economy and society, safety, security, and stability of the life of the people, and “dreams and prospects for a bright future” on to the next generation? Japan is standing at crossroad for the future. We have to work on revitalization of the nation, keeping the sense of impending crisis in mind. This is the responsibility of the current generation for the future generations, and now is the crucial moment.

What are ideal shapes of Japan’s society and economy in the future? What are the challenges to realize them? How can science, technology and innovation contribute to overcoming the challenges? It is essential to come out with the whole picture of the science, technology and innovation policies as problem-solving strategy packages, and this Comprehensive Strategy on Science, Technology and Innovation is it.

(2) Japan’s science, technology and innovation facing setbacks

Science, technology and innovation is the driving force of economic growth and the source of vitality. It can change the structure of the society drastically, and thereby cause a paradigm shift in the society. Looking back at post-world war II Japan, science, technology and innovation was the driving force that led the rapid economic growth, the breakthrough to overcome numerous crises such as the oil crisis, and the leverage that converted crises into opportunities.

However, lately, there are increasing concerns over declining in international competitiveness of Japan’s science, technology and innovation and the eventual declining presence of Japan’s industries, in synchronization with the loss of economic and social vitality and spread of sense of stagnancy in the society. Japan’s position in the international competitiveness rankings on innovations has sharply fallen from 4th in 2007 to 25th in 2012. Japan’s share in the high-tech industry fell from 27% in 1995 to 13% in 2010, while China’s share jumped from 3% to 19%. Even in the field of scientific researches, such tendency can be observed: China’s share made a remarkable increase from 3% in 2000 to 10% in 2010 while Japan’s share in the production of influential papers decreased from 8% to 6%. Overall, the position of Japan’s science, technology and innovation is relatively falling into harsh situation.

(3) Increasing expectation on science, technology and innovation

As described above, Japan is facing increasingly tougher medium- to long-term economic conditions and exhaustion in the whole society due to the decline in economic vitality. At this rate, the whole economic system may stall. Japan is facing such an unusual emergency. As a result, expectations placed on the roles of science, technology and innovation policies are now ever growing.

Science, technology and innovation plays and serves various roles and purposes in the society, such as contribution to progress of mankind, pioneering the state-of-the-art 'intelligence' area, contribution to economic growth, and improvement in the convenience and quality of life. However, for the time being, the potential of science, technology and innovation shall be solely and fully utilized for achieving economic recovery, which is Japan's biggest and pressing challenge. Japan has to make this year "The first year of economic recovery."

It is up to the science, technology and innovation whether or not we will be able to get out of the present predicament by opening up the frontier of the growth. That means science, technology and innovation is tasked to become a) the "engine of economic growth" that leads cultivation of promising markets for Japan's industries, b) the "means of contributing to the world", we can proudly use for solving global environmental issues, etc., and c) the "Trump card for overcoming constraints and challenges" Japan faces. Expectations placed on leading researchers and people involved in science, technology and innovation have never been this high before.

Can science, technology and innovation meet these demands? That is the very question. Japan's science, technology and innovation used to achieve brilliant results thanks to unremitting dedication of talented researchers and logistics supports by the whole society. Now that, Japan is facing severe hardships, Japan has to return to the starting point and reconsider "whether science, technology and innovation meets the needs of the economic society, whether its results are reflected onto the economic society, and whether research and development activities are conducted by always taking account of these aspects." The science, technology and innovation policies thus also require changes in thinking and implementation of an "exit-oriented" problem-solving policy management that connects the results of science, technology and innovation to realization of the concrete shapes of economic society.

Other countries have already been focusing on innovation as a national strategy. Recognizing strongly that the world has now entered into the "era of 'intelligence' mega-competition," Japan will strongly propel its activities toward establishing "the most innovation-friendly country in the world."

(4) Formulation of "Innovation 25" and its progress

In June 2007, the first Abe Administration made a cabinet decision on the Long-term Strategic Guidelines "Innovation 25" which is the long-term strategy for 20 years overlooking.

"Innovation 25" recognized rapid progress of Japan's population decline and aging, explosive progress of knowledge and information society and globalization,

and the issues that threaten the sustainability of the earth. Based on these recognitions, five society images were delineated as the shapes of Japan in 2025 established through innovations, namely "society where everyone can stay healthy throughout life," "safe and secure society," "society that embraces diversity in life," "society that contributes to solving the global issues," and "society open to the world." Activities for integrally promoting the science, technology and innovation policies and reform of the social system then commenced in order to achieve realization of such society images and resolution of social issues. The promotion system was also augmented through cooperation between ministries and by the industry, academia, and government.

However, big changes in circumstances have since occurred. Economic turmoil arose from the Lehman shock and the European fiscal crisis, etc., and unexpected circumstances such as the Great East Japan Earthquake were experienced. Global issues such as environmental issues turned more severe. Many emerging countries from Asia, etc., gained power, worldwide competition in acquisition of natural resources and energy has increased, and the prices of natural resources and energy have skyrocketed. Additionally, the Japanese yen became stronger drastically. Due to these factors, the environment surrounding the promotion of the science, technology and innovation policies became increasingly severe. As a result, activities based on "Innovation 25" were not promoted steadily and effectively due to the lack of adequate and appropriate follow-ups.

Taking account of these changing circumstances, in August 2011, a cabinet decision was made on "The 4th Science and Technology Basic Plan.", a 5-year medium-term plan. Problem-solving science, technology and innovation policies based on the plan are currently promoted. Here, we formulate the comprehensive strategy on science, technology and innovation, which consists of a long-term vision including the whole picture of the science, technology and innovation policies and immediate action programs covering policies on activities toward realization of the long-term vision, based on the recent changes in situations, while maintaining consistency with "The 4th Science and Technology Basic Plan," the medium-term plan.

2. BASIC CONCEPTS OF THE COMPREHENSIVE STRATEGY ON SCIENCE, TECHNOLOGY AND INNOVATION

Under the recognition of the current situation described above and experiences of and reflection from promoting "Innovation 25," the comprehensive strategy on science, technology and innovation is formulated based on the basic concepts below. The purpose of the strategy is to achieve economic recovery, which is Japan's most pressing issue, and to materialize the ideal economic society, by taking advantage of science, technology and innovation.

(1) Six principles required for managing science and technology policies

It is essential to set a high value on the following six principles in order to strongly promote science and technology policies. The Strategy is also formulated based on these principles.

< Principle 1 > Build strategies with clear time frame and goals

Detailed strategies are prepared and implemented, namely "What kind of society will be realized by when" and "For that, who will carry out what and achieve what kind of results by when."

< Principle 2 > Conduct comprehensive policy management grasping the whole picture of science, technology and innovation

Priorities of promotion will be strategically determined grasping the whole picture. Avoid making the policy "not seeing the wood for the trees."

< Principle 3 > Produce policies seamlessly covering the "upstream" and "downstream" research and development stages from the "upstream" through to the "downstream"

In addition to the conventional coverage of technology research and development stages "from basic researches, through applied researches, and to practical application," the "upstream" and "downstream" stages will also be included, resulting in thorough policy management "from higher education, through researcher training, basic research and applied research, practical application and industrialization, and to diffusion and market development." Each stage will be strongly promoted and seamlessly connected to the next stage, maintaining global perspective throughout.

< Principle 4 > Clarify the role of each player and establish collaboration between industry, academia, and government

The industry, academia, and government as the players of science, technology and innovation collaborate with each other playing respective roles. In the government, under the direction of the Council for Science and Technology Policy as headquarters, cooperation among ministries will be established by clarifying responsible ministries and silos will be removed.

< Principle 5 > Coordinate and combine various policy measures

Policy management will be effectively and efficiently conducted by combining various policy measures, such as budgeting and taxing, financing, and system reform (regulatory reform), in order to utilize the complementarities.

< Principle 6 > Evaluate and revise the policy measures through annual PDCA¹ process, which is directly connected to budgeting

Evaluation of measures will be conducted regularly on implementation status of the policies and achievement level of goals. Revisions will be made as necessary.

(2) Basic concepts of the Comprehensive Strategy on Science, Technology and Innovation

The Comprehensive Strategy on Science, Technology and Innovation is formulated under the six principles above, and specifically follows the basic concepts below.

Firstly, the Strategy consists of a long-term vision including the whole picture of the science, technology and innovation policies (ideal economic society, policy issues, and achievement goals) and immediate action program that entails policies on activities toward realizing the long-term vision in a roadmap.

The target year of the long-term vision is 2030. The long-term vision provides the grand design of Japan's ideal economic society as well as policy issues toward achievement goals, from the viewpoint of science, technology and innovation. Detailed policies and intermediate targets for solving policy issues and achieving goals are clarified in a roadmap with a timeframe. Implementation will be followed up as needed, and PDCA cycles become feasible by revising the roadmap.

Secondly, the Strategy is a comprehensive package of problem-solving science, Technology and Innovation policies. The Strategy establishes a problem-solving policy system (program) targeting contribution of science, technology and innovation to the various issues that Japan's economic society faces. By that, the Strategy provides the nation with the direction of the Science, Technology and Innovation policies as a whole, rather than to consider science, technology and innovation by sectors.

Thirdly, the Strategy is formulated for the nation as a whole. Researchers, companies, universities, research institutions, and the general public are all leading players with important roles and responsibilities. Therefore, division of roles is clarified in the Strategy, keeping cooperation of the industry, academia, and government in mind. The ministries responsible for conducting the policies are also clarified. A combination of policy measures is presented, such as budgeting and taxing, financing, regulatory reform, and so on.

¹ Plan-Do-Check-Action

II. FUTURE OF JAPAN CREATED THROUGH SCIENCE, TECHNOLOGY AND INNOVATION — LONG-TERM VISION

1. SHAPES OF THE NATION TO BE ATTAINED IN 2030

What are the medium- to long-term trends of changes in situations Japan may face till 2030? The Long-term Strategic Guidelines “Innovation 25” formulated in 2007 predicted that the following three trends would further progress:

- 1) A declining population and rapid aging in Japan**
- 2) Explosive development of knowledge society, information society, and globalization**
- 3) Increase of issues that threaten sustainability of the earth (population, natural resources and energy, climate change and environment change, water and food, terrorism, infectious diseases)**

Six years have passed since then, and the issues above have clearly progressed and turned dire. For instance, the worldwide economic crises caused by the Lehman shock and the European fiscal crisis have incidentally proven rapid globalization of the world even for negative effects, by spreading the crises all over the world in a very short period of time.

By taking account of subsequent changes in the situation, the following two trends must also be considered:

- 4) Structural changes in the international economic society due to rapid growth of emerging countries**
- 5) Increased urgency for preparation against natural disasters**

Amid such trends of the time, what kind of economic society may Japan seek? What kind of economic society shall Japan build by 2030 and pass it on to future generations?

This strategy sets the following three images as Japan’s ideal economic society.

(1) Economy that maintains the world-top-class economic strength and develops sustainably

Frequent and abundant innovations maintain and strengthen the vitality and international competitiveness of Japan’s industries. Industrial activities develop dynamically and globally, and a high international position has established through gaining credibility and demands home and abroad. With that, the nation’s employment and income are secured, supporting their lives. Negative factors on

economic growth, such as decline in working population, are complemented by science and technology and are not any more a concern for economic activities. Energy constraints are not a burden on economic growth; the supply and utilization of energies are conducted safely, stably, and efficiently. Revitalization of economic activities and further improvement of the efficiency of public sectors have contributed to improvements in financial situations. Regional municipalities take advantage of individual “strengths” to provide active, safe, and quality lifestyles, establishing regional economic societies that are internationally attractive.

(2) Society where the people can enjoy wellness, security and safety

The people realize their standards of living are maintained and improving. Active society is sustained even under population decrease, aging, and declining birthrate. A promising working environment is established, where women and young people can fully demonstrate their abilities. People can fulfill their healthy, affluent, and happy lives. Especially, elderly people are living actively, safely, and comfortably. There is no health disparity, and secure living is achieved by prompt rehabilitation in society after illness or injuries by curing them or easing the severity of symptoms. The whole nation is engulfed in a sense of security. Everybody has prospects of bright future and clear life plans. Additionally, the next-generation infrastructure is established, securing the safety of people’s lives and properties against natural disasters, etc.

(3) Economic society that harmonizes with the world and contributes to the progress of humankind

Japan harmonizes with the world, and has become a model advanced country confronted with challenges like aging population. A low-carbon society has been established, achieving integration of environment conservation and active human living. Japan leads the development of the world’s “intelligence” frontier, and contributes to the future of mankind. The status of “national human resources” has been established by providing various talents worldwide, resulting in inflow of people, products, money, and intelligence, and Japan has become a platform of lively economic society.

2. CREATING AN ENVIRONMENT THAT FACILITATES SCIENCE, TECHNOLOGY AND INNOVATION

Innovations become the driving force of economic growth and contribute to solving social issues. Therefore, innovations are essentially needed to make Japan a

“growth center.” By making Japan “the world’s most innovation-friendly country,” We can attract talents from the world and develop “new possibilities.” Japan has to become the source of innovations.

“An innovation-friendly country” means a country where the framework of the society encourages many various innovation leaders to fully utilize their talents. Innovations stem from people, and require many people to play various roles such as creation of intelligence, its diffusion and application, augmentation and reformation of existing industries, and creation of new industries. It is also essential to create a social environment that positively allows taking risks and costs involved in innovations for the sake of the future of Japan.

In order to establish an environment suited for science, technology and innovation, Japan has to break away from the conventional method that accumulated individual measures. The innovation system has to be propelled by grasping the whole picture of the society in order to establish an environment that facilitates growth of innovation sprouts, rather than conducting partial optimization of each measure. Conventionally, an innovation completed by itself; achievements obtained from basic researches were handed over to practical application and market development, and no further action was taken. However, it is possible that an innovation leads to creation of new research themes and ideas, promotion of more basic researches, enrichment of research talents and environments, and progress of research and development—a positive cycle of chain innovation reactions. It is important to foster an environment that continually facilitates innovations by establishing such chain innovation cycles.

Under these points of view, the role of the Japanese government is to establish a framework that promotes innovations by combining various policies. The policies include institutional designing for human resources development, basic researches as well as research and development related to innovations, and review of regulations that are becoming the bottlenecks of innovations.

3. IMMEDIATE PRIORITY POLICY ISSUES FOR REALIZATION OF THE IDEAL ECONOMIC SOCIETY.

In order to realize Japan’s ideal economic society in 2030 and to strongly promote Japan’s economic revitalization which is the most urgent issue, the immediate policy issues of the science, technology and innovation policies are laid out as below. These policy issues will be addressed intensively.

(1) Realization of a clean and economic energy system

Clean and economic energy will be secured to maintain affluent life of people and resolve the energy constraints that become the bottleneck of economic growth. An environment will be established where the energy sector can globally expand as the

main industry. Additionally, global environment issues will be actively addressed, to achieve the target to reduce the greenhouse gas emissions by 80% by 2050. Global warming diplomatic strategies will be actively expanded, to contribute to the world with the technologies.

For that, research and development, practical application, and commercialization will be promoted. By doing so, stronger competitiveness of core technologies, expansion of income and job opportunities as well as market acquisition, reduction of energy costs, contribution to the energy security, and a reduction in environmental burdens will be realized.

(2) Realization of healthy and active ageing society as a top-runner in the world

People's healthy life expectancy (the period of time that people can live without having any restrictions due to health issues) will be extended through "health promotion," "preventive medicine," and "supportive medicine and nursing," in addition to "treatment medicine." A society with no health disparity will be established, where people can fulfill their affluent lives healthily and happily, promptly return to the society after illness or injuries, and feel secure. Japan is to become the world's leading "health country," as Japan is an advanced country with challenge coming from rapid progress of aging that will confront the world later on. The world-class technology in health and medical areas will be maintained, while international competitiveness of medical supply and medical equipment industries will be improved. Such medical industries will be developed into the leading industries of Japan.

(3) Development of next generation infrastructures as a top-runner in the world

Infrastructure is the important foundation of a nation's living and economic society activities. However, the environment surrounding Japan's infrastructure has drastically changed due to decreasing population, aging and declining birthrate, transition of the industry structures, needs of preparation for large-scale natural disasters, and aging of the existing infrastructure. Due to these changes, the needs for infrastructures have also changed, namely to sustain the vitality of the economic society, provide safe and convenient living for all the people including elderly people, and allow dynamic and global expansion of industrial activities. Infrastructures utilizing the cutting-edge technologies such as information technologies will be developed in order to meet such needs. Also, all public and private institutions will work together on establishing a resilient nation against natural disasters where the people can feel safe and secure. Such infrastructures

are assets of the nation to be passed onto future generations, and are to be established strategically and effectively. Infrastructure industries will be improved in international competitiveness and developed into world-leading industries, by utilizing Japan's technological strengths.

(4) Regional revitalization taking advantage of regional resources

Regional communities have various regional resources such as natural resources (e.g., water, forest, underground resources, climate), human and intellectual resources (e.g., human resources, universities, research institutions), economic resources (e.g., industries, infrastructure and facilities, industrial technologies), and social resources (e.g., social systems, traditional cultures, tourism resources). It is important to combine these resources and turn them into "assets" with increased added-value, so that the regional communities can take advantage of them as "strengths." This process will be accelerated by science, technology and innovation acting as an intermediary.

By utilizing such "strengths" as individual characteristics, regional communities will provide active, secure, and quality life, resulting in establishing internationally attractive regional economic societies. As a result, Japan will be highly diverse in its composition, and regional communities will directly connect to the world and demonstrate their presence as key players in global competition.

(5) Early recovery and revitalization from the great east japan earthquake

Two years have passed since the unprecedented disaster of the Great East Japan Earthquake and the incident at the Tokyo Electric Power Company Fukushima Daiichi Nuclear Power Station. The whole nation has since been working on reconstruction. Reconstruction and recovery are Japan's top priority, and will be further promoted. The reconstruction is not going to stop just at "rebuilding bare necessities." It will create "the new Tohoku region" as a place of creation and possibilities. Taking account of the points above, a resilient nation against natural disasters will be built, in order not only to protect the nation's lives and properties but also to secure the resistance and resilience of the whole economic society system. The reconstruction process of the disaster areas will also contribute to establishing "society that watches over healthy and sound growth of children," "active super-aging society," "society with sustainable energies," and "society that fully utilizes regional resources of the Tohoku region as 'strengths'." These activities will be effectively and efficiently conducted by fully utilizing science, technology and innovation.

4. THREE PERSPECTIVES FOR PROMOTING THE SCIENCE, TECHNOLOGY AND INNOVATION POLICIES

The Science, Technology and Innovation policies of each area will be promoted under the three perspectives of "Acting *Smart*," "Implementing *System* thinking," and "Thinking *Global*."

« Perspective 1 » "Acting Smart" ➤ "Aim at making each industry knowledge-based"

Information technology (IT) can be the device for opening up various future possibilities. For instance, utilization of IT in various areas can improve the convenience in people's living, improve efficiency and productivity of economic activities, and contribute to cultivating new business frontiers. Therefore, IT will be introduced and utilized at various stages of economic activities, such as research and development, human resources development, designing, production, distribution, and consumption.

However, simple introduction of IT and networks is not enough. Improved efficiency, labor saving, and productivity are not the only benefits of IT. Information will not only be interlinked by IT but also be accumulated and utilized. Through those actions, activities will be conducted with views to make industries knowledge-based and to change the way the society revolves (e.g., use of agri-informatics technology to make agriculture knowledge-based).

«Perspective 2 » Implementing system thinking ➤ "Double the value by combining 'strengths'"

Japan has many products and technologies that are the best or one of a kind in the world. However, in many cases, they do not have the market share that they deserve. The added value of such superior products and technologies will be increased by combining and systemizing them, rather than producing them individually, in order to secure their market competitiveness (e.g., smart community, intelligent transport system).

«Perspective 3 » Thinking global ➤ "Look higher and into the world"

From now on, each individual, company, university, regional society, as well as the government has to act with a view of interactions not only domestically but also internationally.

For instance, each country is strongly propelling policy packages to promote innovation as national strategies. Therefore, the Japanese government has to manage the Science, Technology and Innovation policies, realizing that international "intelligence" mega-competition is

currently taking place. Each entity such as enterprise, research institution, or regional community is also required to act with viewing global competition, international marketing, and overseas expansion. It is also important to import overseas talents, technologies, and funds as well as exporting Japan's talents and technologies, so that Japan becomes the platform of science, technology and innovation, namely, "the most innovation-friendly country in the world."

CHAPTER 2 CHALLENGES TO BE ADDRESSED BY SCIENCE, TECHNOLOGY AND INNOVATION

The following challenges that are to be addressed by science, technology and innovation as described in Chapter 1 will be intensively tackled in order to realize Japan's ideal economic society in 2030 and to strongly promote Japan's economic revitalization which is the most pressing issue.

- I. Realization of a Clean and Economic Energy System
- II. Realization of Healthy and Active Ageing Society as a Top-Runner in the World
- III. Development of Next Generation Infrastructures as a Top-Runner in the World
- IV. Regional Revitalization Taking Advantage of Regional Resources
- V. Early Recovery and Revitalization from the Great East Japan Earthquake

I. REALIZATION OF A CLEAN AND ECONOMIC ENERGY SYSTEM

1. BASIC UNDERSTANDING

Japan's electric energy situation has changed since the incident at the Tokyo Electric Power Company Fukushima Daiichi Nuclear Power Station. Due to closure of nuclear power plants, power supply is now largely relying on thermal generation. As a result, it is inevitable to emit a large amount of greenhouse gas for the time being. Generally, decades are required for the development, practical application, and diffusion of new energy technologies, and diffusion and expansion of new energy sources are unlikely to come into sight for some time. Therefore, fossil fuel will remain as the important source of energy in Japan, even in a medium- to long-term view. Incidentally, energy demand in the world is likely to rise in future due to emerging countries, which may result in a huge impact on the global environment. Under such conditions, energy policies are currently reviewed.

Establishing a society with a safe and stable supply of clean low-cost energies in accordance with changes in the energy environment will greatly contribute to strengthening industrial competitiveness, and is an important task in a medium- to long-term view. Such a society will become the very base for sustaining affluent life of the people. It is also necessary to improve energy efficiency through innovative energy-saving materials and technologies, so that low-energy society will be realized while reducing environmental burden such as greenhouse gas emissions mainly arising from fossil fuel burning. Establishing an organic energy system where energy is supplied in the forms of electricity, heat, and chemicals will realize a society with integrated advanced energy networks that promote use of various energy sources. The above plans are also important in terms of reducing outflow of

the national wealth, as Japan is highly reliant on foreign countries for the supply of fossil resources, etc.

Science, technology and innovation in the field of energy will contribute to strengthening the international competitiveness of core technologies, taking the leadership in the world's industry, acquiring the markets, expanding the people's income and job opportunities, and proposing new energy systems. To realize the above-mentioned plans, it is necessary for technology development to focus on reduction of energy costs, assurance of energy security, and reduction of environmental burdens.

2. FOCUSED POLICY CHALLENGES

Here, the energy system is divided into three stages, namely production, consumption, and distribution. By considering the characteristics of each stage, the focused policy challenges are set for achieving the "Realization of a Clean and Economic Energy System."

For the production stage, "Stable and low-cost supply of clean energy" is set as a focused policy challenge. Japan is not rich in natural resources, and requires safe, stable, and economical acquisition and efficient utilization of primary energy sources such as renewable energies and fossil resources. Use of renewable energy is spreading, yet relevant industries face cost competition with overseas products. Therefore, strengthening competitiveness of the relevant industries through innovative technology development becomes the major task. Developing clean energy supply technologies, which are low in greenhouse gas emissions and high in economic efficiency, is also effective in terms of actions toward the climate change. Additionally, from the viewpoint of diversification of energy resource acquisition, it is also important to develop new energy conversion technologies as well as new technologies for developing energies that have not been developed to date due to technical reasons (e.g., marine energies and resources).

For the consumption stage, from the consumers' viewpoint, "Improved utilization efficiency and consumption reduction through new technologies" is set as a focused policy challenge. Japan has increased its energy efficiency (energy supply divided by gross domestic product) by 40% since the 1973 oil crisis, which currently is the best standard in the world. Energy-saving technologies developed in that period have also contributed to improving industrial competitiveness. In response to energy restrictions after the Great East Japan Earthquake, efforts have been made on reduction of energy consumption through energy and electricity conservation and leveling of energy demands. In order to assist these efforts, energy- and electricity-saving products are required, while maintaining and improving the quality of the people's living. The important task here is to develop and diffuse energy-controlling technologies that improve energy efficiency at the demand side, as well as to

promote technology development of innovative devices and structural materials that will become base of the new products.

For the distribution stage, “Integration of sophisticated energy networks” is set as a focused policy challenge. Here, the target will be to make energy consumption cleaner by linking energy networks established at local or wide-area levels. Especially, supplying a large amount of energy using various widespread energy sources is planned, which requires overcoming output fluctuations in order to realize a stable supply of energy. Therefore, it will be important to develop stationary and mobile energy carriers, media, and next-generation batteries for “storing” and “delivering” energies, and technologies for using and managing these energy storing/delivering systems by utilizing the information and communication technologies.

Realization of a Clean and Economic Energy System

Focused Policy Challenges	Focused Measures
Stable and low-cost supply of clean energy (Production)	(1) Increase of the supply of renewable energies through innovative technologies
	(2) Realizing highly efficient and clean innovative technologies for power generation and combustion
	(3) Diversifying sources and resources of energy
Improved utilization efficiency and consumption reduction through new technologies (Consumption)	(4) Efficient energy utilization through the development of innovative devices
	(5) Efficient energy utilization through the development of innovative structural materials
	(6) Sophisticating technologies for energy utilization on the demand side
Integration of sophisticated energy networks (Distribution)	(7) Establishing network systems to promote diverse energy utilization
	(8) Sophisticating innovative technologies for transformation, storage and transportation of energy

3. FOCUSED MEASURES

[Appendix: Roadmap Energy]

(1) Increase of the supply of renewable energies through innovative technologies

[Roadmap Energy (1)]

1. Details

Research and development will be promoted for devices, system technologies, and network technologies pertaining to electricity generation, electricity transmission, electricity distribution, electricity storage, heat utilization, and heat recovery that are suitable for expanding the use of renewable energies as well as efficient use of energies by utilizing local characteristics. Especially, advancement in floating offshore wind power, innovative photovoltaic power generation, and geothermal power generation will be promoted, which have abundant potential resources and utilize local characteristics and meteorological conditions. Research and development of installation methods and maintenance technologies will also be promoted. These advancements and developments will result in major improvements in economic efficiency and conversion efficiency of renewable energy utilization systems. Through these activities, a society that fully utilizes clean renewable energies will be realized.

[Cabinet Secretariat (CAS), Ministry of Internal Affairs and Communications (MIC), Ministry of Education, Culture, Sports, Science and Technology (MEXT), Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and Ministry of the Environment (MOE)]

2. Main Measures toward Social Implementation

- Establishment of environment, regulations, and systems related to installation and security of renewable energy systems

[CAS, MAFF, METI, MLIT, MOE]

- Promotion of international standardization of technical standards, authentication systems, etc., pertaining to strengthening of international competitiveness

[MIC, Ministry of Foreign Affairs (MOFA), METI, MLIT, MOE]

- Promotion of activities related to ensuring social acceptability

[CAS, MIC, MAFF, MLIT, MOE]

3. Goals to Be Achieved by 2030

Resolution of technical issues for diffusion of renewable energies

- Practical application of floating offshore wind power stations aiming for 2018
- Reduction in solar power generation costs to less than 7 yen/kWh from 2030

(2) Realizing highly efficient and clean innovative technologies for power generation and combustion **[Roadmap Energy (2)]**

1. Details

Technology development will be promoted for improving energy use efficiency as well as reducing environmental impacts. It includes improvement in energy conversion efficiency through improved combustion efficiency and increased temperature for thermal power generation and internal combustion engines, improvement in efficiency of fuel cell power generation, and upgrade of the cascade method for heat use. It also aims at establishment of a clean fossil resources energy system, along with practical application of CO₂ capture and storage technologies. Furthermore, innovative generation and combustion technologies will be realized for achieving global expansion of internationally competitive technologies as well as for contributing to global environment preservation. A society that has achieved both a stable supply of energies and a reduction in environmental impacts will be realized through advanced power generation and combustion technologies.

[MEXT, METI, MOE]

2. Main Measures toward Social Implementation

- Establishment of legal systems (e.g., promoting, licensing) for practical application

[MAFF, METI, MLIT, MOE]

- Promotion of international standardization of the technical standards, authentication systems, etc., pertaining to strengthening of international competitiveness

[MOFA, METI, MOE]

3. Goals to Be Achieved by 2030

Practical application of innovative high-efficiency power generation systems and application of CO₂ capture and storage technologies

- Improvements in efficiency and durability of stationary fuel cells
- Practical application of CO₂ separation, capture, and storage technologies (by around 2020)

(3) Diversifying sources and resources of energy

[Roadmap Energy (3)]

1. Details

Technology development will be conducted for realizing commercialization of currently unused energy sources and natural resources. Especially, research and development will be promoted for inspection and production technologies of ocean resources (e.g., methane hydrates) to realize commercialization of natural resources existing in the ocean around Japan. Technology development will also be promoted for efficient utilization of low-grade carbon resources and advanced transport and storage technologies. Also, technology development will be conducted for innovative catalyst technologies to effectively produce energies and chemicals from various materials such as shale gas, nonconventional crude oil, and CO₂, and for technologies to produce energy resources using microorganisms and biomass. Through these activities, a society with improved energy self-sufficiency rate and advanced energy security will be established.

[MIC, MEXT, MAFF, METI, MLIT, MOE]

2. Main Measures toward Social Implementation

- Evaluation of impacts on the seafloor environment

[MEXT, MOE]

- Establishment of environment to support ocean resources development (e.g., establishment of activity bases, securing marine interests)

[MLIT]

3. Goals to Be Achieved by 2030

Contribution to materialization of diversification of energy sources

- Promotion of technology development for methane hydrates, taking account of international situations, aiming at commencing commercialization projects led by private sectors in the latter half of financial year 2018
- Establishment of next-generation ocean resources development technologies
- Reduction in oil usage through innovative catalyst technologies

(4) Efficient energy utilization through the development of innovative devices

[Roadmap Energy (4)]

1. Details

Research and development and systemization of technologies that contribute to drastic reduction of energy consumption by motors and IT equipment will be promoted. It includes ultra-low energy consumption power devices (e.g., SiC, GaN),

ultra-low energy consumption lightings, ultra-low energy consumption large-scale integrated circuits (LSI; e.g., three-dimensional semiconductors, non-volatile devices), optical devices, and monitors. Through these promotions, advancement in technologies for efficient use of electricity will be achieved. Expanding application of such technologies to transportation, industry, and civil equipment will contribute to greatly reducing energy consumption. Through these activities, new markets for products using innovative devices will be cultivated and Japan's international competitiveness will be strengthened. At the same time, efficient use of energies will be achieved, and a society with internationally expanding advanced technologies will be materialized.

[MIC, MEXT, METI, MLIT, MOE]

2. Main Measures toward Social Implementation

- Promotion of international standardization, normalization, and authentication systems from the technology development stages in order to assist international expansion

[MIC, MOFA, MEXT, METI, MLIT, MOE]

3. Goals to Be Achieved by 2030

Improvement in energy efficiency and reduction of energy consumption through innovative devices

(5) Efficient energy utilization through the development of innovative structural materials **[Roadmap Energy (5)]**

1. Details

New material development (e.g., carbon-based materials such as carbon fibers, metal materials such as magnesium and titanium alloys, innovative steel plates) and research and development of design and junction technologies suited for the new materials will be conducted. Such high-performance materials will be applied to high power consumption equipment such as transportation equipment, and contribute to improved energy conservation effects through weight reduction and improved durability. Through these activities, efficient use of energies will be achieved, and a society whose advanced technology is internationally expanding will be realized.

[MEXT, METI]

2. Main Measures toward Social Implementation

- Promotion of international standardization, normalization, and authentication systems from the technology development stages in order to assist international expansion

[MOFA, MEXT, METI, MLIT]

- Promotion of the Top Runner Program

[METI, MLIT]

3. Goals to Be Achieved by 2030

Improvement in energy efficiency and reduction in energy consumption through innovative structural materials

- Contribution to structural weight reduction by applying innovative materials to cars, aircraft, etc.

(6) Sophisticating technologies for energy utilization on the demand side

[Roadmap **Energy (6)**]

1. Details

Research and development will be conducted for technologies that promote and advance the smart use of energy at the demand side, such as housing, buildings, and communities. Especially, research and development of efficient energy control technologies utilizing battery technologies will be promoted, setting housing and buildings as the priority areas, where energy consumption has increased since the oil crisis. Also, establishment, practical development, and demonstrations of smart communities will be conducted, at areas where intelligent housing or building is built. The measure will also aim at exporting packages of these technologies globally. Furthermore, technology development will also be promoted pertaining to improved energy use efficiency in the production processes at factories and plants. Through these activities, a society with autonomous and stable energy supply and demand will be realized.

[MIC, MEXT, METI, MLIT, MOE]

2. Main Measures toward Social Implementation

- Promotion of international standardization, normalization, and authentication systems from the technology development stages in order to assist international expansion

[MOFA, MIC, MEXT, METI, MLIT, MOE]

- Promotion and expansion of international standards for energy management system, environmental protection, etc.

[METI, MLIT, MOE]

3. Goals to Be Achieved by 2030

Establishment of energy management technologies in housing, buildings, and communities

Expansion of the use of energy management system in private sector

(7) Establishing network systems to promote diverse energy utilization

[Roadmap **Energy (7)**]

1. Details

This aims at establishing wide-area energy networks by integrating local energy networks into the nation's backbone energy network. Local energy networks include renewable energy systems (e.g., solar, biomass) and thermal energy systems. Research and development related to advanced energy use networks will be specifically promoted, where information and communication technologies, large-scale battery technologies, and load control technologies are utilized for the backbone system interconnections in order to cope with energy sources with significant output fluctuations. Through these activities, a society with energy network systems that promote various types of energy use will be materialized.

[MIC, MAFF, MEXT, METI, MLIT, MOE]

2. Main Measures toward Social Implementation

- Establishment and expansion of the framework for wide-area application including municipalities

[CAS, Cabinet Office (CAO), MIC, MEXT, MAFF, METI, MLIT, MOE]

- Promotion of international standardization for system components and system technologies

[MIC, METI, MLIT]

- Establishment of regulations and systems that become bottlenecks for integration or commercialization of the system

[MIC, MAFF, METI, MLIT, MOE]

3. Goals to Be Achieved by 2030

Implementation of advancement technologies for backbone system interconnections

(8) Sophisticating innovative technologies for transformation, storage and transportation of energy [Roadmap **Energy (8)**]

1. Details

Technology development will be promoted for safe and economic conversion, storage, transportation, and use of energies in the forms of electric energy, thermal energy, and chemical energy. Such development is conducted in order to deal with the temporal variations and spatial gaps arising from the utilization of fluctuating and widespread energy sources. Research and development will specifically focus on a) energy carrier utilization technologies that store and transport energy by converting secondary energies into chemical substances (e.g., hydrogen); b) next-generation batteries, which efficiently store electric energy; c) storage, insulation, collection, and electricity conversion technologies for thermal energies; and d) superconductor electricity transmission technologies, which reduce transmission losses. Through these activities, a society will be materialized where use of clean energies is promoted by advanced energy conversion, storage, transport, and use technologies.

[MIC, MEXT, METI, MLIT, MOE]

2. Main Measures toward Social Implementation

- Mitigation of regulations and inspection and review of safety standards which become bottlenecks of industrialization

[MIC, METI, MLIT]

- Promotion of international standardization, normalization, and authentication systems from the technology development stages in order to assist international expansion

[MOFA, MEXT, METI, MLIT]

3. Goals to Be Achieved by 2030

Diffusion and development of hydrogen infrastructure

Implementation of next-generation battery technologies

Implementation of superconductor electricity transmission technologies

II. REALIZATION OF HEALTHY AND ACTIVE AGEING SOCIETY AS A TOP-RUNNER IN THE WORLD

1. BASIC UNDERSTANDING

Japan is the country closest to a healthy active aging society, which is the all-time dream of mankind. Japan is also an advanced country confronted with challenges like aging population, declining birthrate at speed never experienced in any country, as well as change of disease progressing. Japan will overcome these issues ahead of the international community and proactively work on resolving global health issues such as infectious diseases by fully utilizing most advanced science and technology. As a result, an active aging society will be realized, where people can fulfill their healthy, affluent, and happy lives. At the same time, evidences for health promotion will be established, of which the health and medicine industries can take advantage, and international competitiveness of medical supply and equipment will be strengthened.

To achieve that, focused policy challenges about nutrition and diet will be first set by focusing on the concept of "healthy life expectancy." "Health promotion," "preventive medicine," and "supportive medicine and nursing" in addition to "treatment medicine" will then be developed and diffused. It is also important to establish a positive cycle of continuing innovation creation for the future, by strategically working on human resources development and basic researches, practical application, and diffusion, through to marketing.

Policies pertaining to research and development of the field of medicine will respect the measures taken based on the main features of the "Japan version of NIH."

2. FOCUSED POLICY CHALLENGES

In order to realized the world's first active aging society, focused policy challenges are set based on the following three points of view: 1) extending healthy longevity, 2) promoting social inclusion of handicapped adults and children, 3) improving healthy growth of children to be responsible for the next generation. For the diseases relevant to the focused policy challenges, the policy will be deployed under the viewpoints of "health promotion," "preventive medicine," and "supportive medicine and nursing," in addition to "treatment medicine."

For extending healthy life expectancy, lifestyles and diseases that are causing discrepancy between life expectancy and healthy life expectancy will be first identified. Then, activities will be implemented for establishing evidences that can be utilized for improving lifestyles, and for developing innovative prevention, diagnosis, and treatment methods for lifestyle-related diseases, mental diseases, and neurological diseases. Such activities will contribute not only to extending the healthy life expectancy of the people, but also to promoting health and medical industries, developing innovative "from Japan" medical supplies and equipment, and strengthening international competitiveness of medical supply and equipment

industries. At the same time, frameworks for strengthening international competitiveness of these industries will be established. Active efforts will also be made for the development of supportive medicine and establishment of social environment including healthcare delivery systems, for maintaining and improving the quality of social life (e.g., working) while under effects of illness and diseases.

Also, although it is rare, work-related injuries and infections including occupational diseases are the causes of early death, which shortens the healthy life expectancy. Therefore, researches will be conducted for ensuring workers' health and safety and for development of prevention, diagnosis, and treatment methods for infectious diseases. Achievements from these activities are expected to contribute to the international society as well as the extension of healthy life expectancy.

Furthermore, research and development of future medicine will be conducted to contribute to health promotion and prevention of diseases for the next generations. Information technology will be utilized in the health, medical, and nursing industries to further promote comprehensive community healthcare.

For promoting social participation of people with disabilities or cancer, etc., science and technology will be fully utilized for development of regenerative medicine and artificial organs for replacing or complementing physical or organ functions, and for development of life support equipment. In addition, development of innovative prevention, diagnosis, and treatment methods for rare and refractory diseases will be promoted.

For healthy growth of children, who will lead the next generation, improvements will be made on child health index such as the suicide rate of the teens and the obesity rate of the pupils. By focusing on children's weakness against the environment, environmental factors that affect children's health will be identified and reflected in policy implementation, along with conducting appropriate education for children about such factors.

Realization of Healthy and Active Aging Society as a Top-runner in the World

Focused Policy Challenge	Focused Measure
Extension of healthy longevity	(1) Finding evidences for health promotion through epidemiology researches on health and disease prevention effects of nutrition, diet, physical activities, exercises, rests, etc.
	(2) Developing innovative methods of prevention, diagnosis and treatment of;

	(2-1) cancer, cardiovascular diseases, diabetes, and chronic obstructed pulmonary disease
	(2-2) psychiatric and neurological diseases
	(2-3) infectious diseases and improvement of public hygiene
	(2-4) rare and intractable diseases
	(3) Substitution and compensation for physical or organ functions
	(4) Reinforcing industrial competitiveness in the areas of pharmaceuticals and medical devices
	(5) Making workers healthy
	(6) Developing future health care
	(7) Promoting comprehensive local healthcare through the utilization of IT in health, medical treatment and nursing
	(8) Developing BMI ¹ and devices for medical care and nursing at home
Promotion of social inclusion of handicapped adults and children	(2-4) Developing innovative methods of prevention, diagnosis and treatment of rare and intractable diseases [written again]
	(3) Substitution and compensation for physical or organ functions [written again]
	(8) Developing BMI and devices for medical care and nursing at home [written again]
Healthy growth of children to be responsible for the next generation	(9) Improving children's health indicators and elucidating factors to influence upon children's health

¹ Brain Machine Interface

3. FOCUSED MEASURES

[Appendix: Roadmap **Health and Longevity**]

(1) Finding evidences for health promotion through epidemiology researches on health and disease prevention effects of nutrition, diet, physical activities, exercises, rests, etc. [Roadmap **Health and Longevity (1)]**

1. Details

Evidences for health promotion will be sought and found through promoting epidemiology researches, public hygiene studies, and policy researches on the effects of "nutrition and diet," "physical activities and exercises," "rests," etc., onto healthy living and prevention of diseases. This will contribute to promotion of individual health as well as promotion of health- and medicine-related industries.

Through these activities, a society will be realized where the social environment encourages improvement of lifestyles affecting health and prevention of diseases.

2. Main Measures toward Social Implementation

- Support on industrialization of "Health Japan 21," Smart Life Project, "the 2nd Basic Program for *Shokuiku* Promotion" (*shokuiku*: food and nutrition education), and health promotion and disease prevention business by private sectors

3. Goals to Be Achieved by 2030

- Extension of healthy life expectancy, reduction in the difference between healthy life expectancy and life expectancy, extension of life expectancy, establishment of evidences for health promotion, formulation of guidelines, increase in the number of companies participating in the Smart Life Project

(2-1) Developing innovative methods of prevention, diagnosis and treatment of cancer, cardiovascular diseases, diabetes, and chronic obstructed pulmonary disease [Roadmap **Health and Longevity (2)]**

1. Details

Research and development will be advanced for innovative prevention, diagnosis, and treatment methods, taking account of pathogenic effects of chronic inflammation on illness and diseases.

Through these activities, a society will be materialized where people are free from or able to fully manage lifestyle-related diseases affecting the healthy life expectancy, such as "cancer," "cardiovascular diseases," "diabetes," and "chronic obstructive pulmonary disease."

2. Main Measures toward Social Implementation

- Implementation of policies related to “Health Japan 21,” Basic Plan to Promote Cancer Control Programs, and new cancer research strategies following the third-term Comprehensive 10-Year Strategy for Cancer Control

3. Goals to Be Achieved by 2030

- Extension of healthy life expectancy, reduction in the difference between healthy life expectancy and life expectancy, extension of life expectancy, reduction of cancer age-adjusted mortality rate, relief of mental anguish from cancer patients and relatives, and sustenance and improvement in the quality of recuperation period

(2-2) Developing innovative methods of prevention, diagnosis and treatment of psychiatric and neurological diseases

1. Details

Progress will be made on identification of brain functions and development of innovative prevention, diagnosis, and treatment methods for mental and neurological diseases.

Through these activities, a society will be materialized where people are free from or able to fully manage mental and neurological diseases affecting the healthy life expectancy, such as dementia (e.g., Alzheimer’s disease) and depression.

2. Main Measures toward Social Implementation

- Implementation of measures related to mental health welfare, suicide, and elderly welfare

3. Goals to Be Achieved by 2030

- Improvement in activities of daily living (ADLs) and quality of life (QOL) for dementia and depression patients

(2-3) Developing innovative methods of prevention, diagnosis and treatment of infectious diseases and improvement of public hygiene

1. Details

Research and development will be promoted for medicines and next-generation vaccines for infectious diseases as well as public hygiene studies, by utilizing

Japan's strength in immunology. The achievements obtained from these researches will contribute to both domestic and international society.

Through these activities, a society that can effectively deal with new and reemerging infectious diseases will be materialized.

2. Main Measures toward Social Implementation

- Medical supply research and development support business targeting developing countries

3. Goals to Be Achieved by 2030

- Development in medicines and next-generation vaccines for infectious diseases

(2-4) Developing innovative methods of prevention, diagnosis and treatment of rare and intractable diseases

1. Details

Nationwide research will be promoted for clarification of disease conditions and development of treatment methods for diseases that have few patients and no effective treatment. Especially, under international cooperation and collaboration, researches aiming at development and practical application of treatment methods (e.g., innovative drug development) will be promoted, taking account of the pathogenic effects of chronic inflammation on the relevant diseases. Through these activities, a society will be materialized where people are free from rare and refractory diseases or live in the society with dignity even when affected by such diseases. In the future, it is anticipated that prevention and early diagnosis of such diseases will become available, contributing to extension of healthy life expectancy.

2. Main Measures toward Social Implementation

- Measures for refractory diseases, supporting system for research and development orphan drugs
- Creation of a nationwide patient database
- Research on refractory diseases through utilizing disease-specific iPS cells

3. Goals to Be Achieved by 2030

- Development of prevention, diagnosis, and treatment methods for rare and refractory diseases; improvement of ADLs and QOL for patients

(3) Substitution and compensation for physical or organ functions **[Roadmap Health and Longevity (3)]**

1. Details

Research and development will be promoted for regenerative medicine that utilizes iPS cells, somatic stem cells, and embryonic stem cells. Japan's regenerative medicine researches are the most advanced in the world, and an environment that enables early realization of clinical tests of these researches will be established. Innovative drug development researches using iPS cells will also be continuingly conducted. Additionally, the industry, academia, and government will work as a team on promoting research and development of regenerative medicine devices, artificial organs to replace or complement physical or organ functions, and peripheral devices to assist industrialization of such devices, under appropriate intellectual property strategies and international standardization strategies.

By utilizing the achievements gained from the above activities, it is expected that healthy life expectancy will be extended and social participation of people with disabilities or cancer will be promoted.

2. Main Measures toward Social Implementation

- Improvement of regulations in accordance with the characteristics of regenerative medicine and related equipment
- Improvement of the legal systems to ensure safety of regenerative medicine
- Support for bio-ventures

3. Goals to Be Achieved by 2030

- Increase in the number of regulatory approval on regenerative medicine and related products

(4) Reinforcing industrial competitiveness in the areas of pharmaceuticals and medical devices (including promotion of practical application studies of cutting-edge technologies) **[Roadmap Health and Longevity (4)]**

1. Details

Development will be promoted for noninvasive or minimally invasive inspection and early diagnosis technologies, radiotherapy technologies, as well as medical devices such as nanobiodevices, surgery-assisting robots, medical software (e.g., diagnosis assistant), etc. Researches, development, and establishment of support systems will also be promoted for innovative drug development such as biomedicines. At the same time, researches on evaluation of the effectiveness and safety of medical supplies and devices utilizing cutting-edge technologies will be

promoted, and guidelines for developing and inspecting innovative medical technologies will be formulated.

Through these activities, a society will be materialized where its medical supply and equipment industries are internationally competitive and have become the leading industries.

2. Main Measures toward Social Implementation

- Establishment of evaluation methods for innovative medicine technologies
- System improvement of an independent administrative agency, the Pharmaceuticals and Medical Devices Agency
- Five-year Clinical Research and Trial Activation Plan 2012
- Improvement of legal systems such as the Pharmaceutical Affairs Act
- Promotion of international expansion of medical technologies and medical services packages led by the main entity of international expansion of medicine, the “general incorporated association Medical Excellence Japan”
- Improvement of the functions of support networks for innovative medicine development
- Establishment of clinical research key hospitals, etc.

3. Goals to Be Achieved by 2030

- Increase in the number of international clinical trials; increase in the number of innovative “from Japan” medical supplies and devices
- Formulation and utilization of guidelines for developing and inspecting innovative medical technologies

(5) Making workers healthy

[Roadmap Health and Longevity (5)]

1. Details

Occupational safety and health researches will be promoted in order to prevent occupational illness and injuries, which affect the healthy life expectancy of workers. Relevant activities based on the achievements gained from such researches will also be promoted. A wide variety of workers, including the tertiary industries (e.g., services) are covered.

Through these activities, a society will be materialized where everybody can work healthily and in peace, and improvement in workers’ health and labor productivity will be achieved.

2. Main Measures toward Social Implementation

- Various activities based on the Industrial Accident Prevention Plan

3. Goals to Be Achieved by 2030

- Reduction in industrial accidents

(6) Developing future health care (e.g., genome cohort, bio-resources bank, promotion of cost–benefit analysis studies on medical technologies, bioethics studies) [Roadmap **Health and Longevity (6)]**

1. Details

Genome cohort researches aiming at creating preemptive medicine, establishment of bio-resources banks and integrated database of life science research results, and basic researches for establishing the “One Patient, One Record” system will be promoted. Cost–benefit analysis studies on medical technologies and bioethics studies will also be promoted.

Through these activities, a society will be materialized where people are cared for by early-intervention medicine of the future, the so-called preemptive medicine, which focuses on characteristics of the individuals.

2. Main Measures toward Social Implementation

- Tohoku Medical Megabank, Biobank Japan, National Center Biobank, etc.
- Establishment of integrated database and development of highly specialized human resources required

3. Goals to Be Achieved by 2030

- High-quality cohort researches, stable operation of bio-resources banks, expansion of preemptive medicine utilizing meta-analysis results, etc., of genome cohort researches

(7) Promoting comprehensive local healthcare through the utilization of IT in health, medical treatment and nursing [Roadmap **Health and Longevity (7)]**

1. Details

IT will be utilized in health, medical, and nursing.

Through these activities, establishment of comprehensive community healthcare systems will be promoted.

2. Main Measures toward Social Implementation

- Promotion of a system where the individuals can utilize their own medical and health information
- Information sharing of home care and nursing
- Promotion of visualization of nursing- and medicine-related information
- Improvement of safety measures for medical supplies, etc., by using standardized medical information database
- Consideration and inspection of watching services and health maintenance and management technologies for elderly people that fully utilize information technologies, from the point of view of establishing the next-generation housing and communities

3. Goals to Be Achieved by 2030

- Expansion of the areas adopting comprehensive community healthcare systems which utilize IT

(8) Developing BMI and devices for medical care and nursing at home

[Roadmap Health and Longevity (8)]

1. Details

Research and development will be conducted for BMI and equipment related to home care and nursing. These activities will promote improvement in ADLs and QOL of elderly people and people with disabilities, alleviation of burden on the caretakers, and development of related industries in Japan. As a result, a society that facilitates social participation of people with disabilities will be materialized. In the future, this is expected to contribute to extending healthy life expectancy.

2. Main Measures toward Social Implementation

- Implementation of policies for people with disabilities
- Establishment of certification systems and international standardization pertaining to the safety of life support robots
- Promotion of development and implementation as well as support of practical application of equipment related to home care and nursing such as nursing robots
- Resolution of bioethics issues

3. Goals to Be Achieved by 2030

- Promotion of social participation of people with disabilities
- Improvement in ADLs and QOL of elderly people and people with disabilities
- Promotion of independency for elderly people; alleviation of burden on the caretakers

(9) Improving children’s health indicators and elucidating factors to influence upon children’s health [Roadmap **Health and Longevity (9)**]

1. Details

Medical researches on health, refractory chronic medical conditions, etc., of children, and identification of environmental factors that affect children’s health will be promoted. Researches on childhood cancer will also be promoted, which is the most common reason of children’s death among all illnesses and diseases. Additionally, a society that cares for children’s health and disease prevention for children will be materialized by conducting appropriate education about environmental factors that affect illness, diseases, or health.

2. Main Measures toward Social Implementation

- Japan Environment and Children’s Study, Healthy Parent and Child 21, Research into Treatment for Specific Child Chronic Diseases, various policies for school health, perinatal care measures, Basic Plan to Promote Cancer Control Programs

3. Goals to Be Achieved by 2030

- Reduction in the suicide rate of teens, improvement in the child health index such as the obesity rate of pupils

III. DEVELOPMENT OF NEXT GENERATION INFRASTRUCTURES AS A TOP-RUNNER IN THE WORLD

1. BASIC UNDERSTANDING

The social environment surrounding Japan has been rapidly changing, such as population decreasing and aging, declining birthrate, transition in the industrial structure, and the necessity of preparation for large-scale natural disasters. Accordingly, the quality of infrastructure required by the society has changed. Incidentally, the infrastructures established during the high economic growth era now all requires reconstruction or renovation, resulting in an increase in the investment demand pertaining to costly maintenance, repair, and update of such infrastructure. However, the infrastructure-supplying capacity of the public sector has decreased due to degeneration in financial conditions.

In order to appropriately respond to such changes in the situations and in order to build a safe, secure, and vibrant society, it is essential to strategically and efficiently establish the infrastructure. Such infrastructure strengthens the basis of economic growth and becomes an important asset of the nation to be handed over to the future generations. Along with building the basis to promote Japan’s economic growth, it is also important to develop the infrastructure industry into the world-

leading exporting industry of Japan, by taking advantage of technologies and experiences Japan has accumulated to date.

For realizing the next-generation infrastructure, science, technology and innovation is not only tasked to advance and optimize the existing works, functions, and services, but also tasked to create works, functions, and services of which the current technologies are not capable.

2. FOCUSED POLICY CHALLENGES

In order to promote countermeasures against aging infrastructure amid the recent dire financial situation, it is necessary to increase the reliability of the infrastructure by conducting appropriate inspection and diagnosis even for the hard-to-reach locations as well as reducing the costs required for maintenance and update operations. Therefore, “ensuring safety and security of the infrastructures” is set as a focused policy challenge.

Also, in order to protect the nation’s lives and properties from large-scale natural disasters, both private and public sectors work together on establishing strong and flexible infrastructure, fully utilizing both software and hardware. Therefore, “reinforcing resilient function for preventing and mitigating disasters” is set as a focused policy challenge.

Furthermore, Japan’s technology development and practical application have progressed ahead of the world for some fields such as the intelligent transport system and the information and communication technology, and it is important to establish infrastructure that can accommodate economic growth through further advancement in technologies. Therefore, “regional and town revitalization through establishing next-generation infrastructures” is set as a focused policy challenge.

Development of next generation Infrastructures as a top-runner in the world

Focused Policy Challenge	Focused Measure
Ensuring safety and security of the infrastructures	(1) Realizing effective and efficient maintenance, management and renewal of infrastructures
Reinforcing resilient function for preventing and mitigating disasters	(2) Realizing resilient infrastructures against natural disasters
Regional and town	(3) Realizing integrated transport systems

revitalization through establishing next-generation infrastructures	(4) Realizing the base for next-generation infrastructures
---	--

3. FOCUSED MEASURES [Appendix: Roadmap **Next-Generation Infrastructure**]

(1) Realizing effective and efficient maintenance, management and renewal of infrastructures [Roadmap **Next-Generation Infrastructure (1)**]

1. Details

Development will be promoted for technologies that effectively and efficiently inspect and diagnose deterioration and damage of the constructions, and for technologies that improve endurance of the structural materials of infrastructures. Through these activities, safe and appropriate actions against disasters and in hard-to-reach locations will become available, and strategic actions will be taken for the rapidly deteriorating infrastructure considering the balance of the costs and safety. As a result, a society will be materialized where people can safely use the infrastructure for a long period of time.

[CAS, MIC, MEXT, METI, MLIT]

2. Main Measures toward Social Implementation

- Activities toward international standardization and international expansion from the technology development stages

[MIC, MOFA, MEXT, METI, MLIT]

- Practicability evaluation of the developed technologies utilizing the field; pioneering introduction of the developed technologies in public procurement

[MLIT]

3. Goals to Be Achieved by 2030

- Materialization of low-cost infrastructure that sustainably supports people's living and industrial activities

(2) Realizing resilient infrastructures against natural disasters

[Roadmap **Next-Generation Infrastructure (2)**]

1. Details

Development of the following technologies will be promoted under collaboration by private and public sectors: a) technologies that strengthen the infrastructure such as improved earthquake resistance; b) observation, analysis, and prediction technologies by utilizing the earth observation data and geospatial information obtained by satellites and such; c) technologies that minimize damage from disasters by promptly and accurately acquiring and transmitting necessary information; d) technologies that facilitate safe, prompt, and appropriate countermeasures and recovery after disasters. Through these activities, the nation will be able to take actions (e.g., evacuation) against disasters in advance, and both disaster victims and rescuers will be able to take safe and prompt post-incident actions. As a result, a society will be materialized where people can feel safe and secure against various disasters including natural disasters.

[CAS, CAO, MIC, MEXT, METI, MLIT]

2. Main Measures toward Social Implementation

- Activities toward international framework building, international standardization, and international expansion from the technology development stages

[CAS, CAO, MIC, MOFA, MEXT, METI, MLIT]

- Practicability evaluation of the developed technologies utilizing the field; pioneering introduction of the developed technologies in public procurement

[MLIT]

3. Goals to Be Achieved by 2030

- Realization of society that minimizes damage from disasters

(3) Realizing integrated transport systems

[Roadmap **Next-Generation Infrastructure (3)**]

1. Details

Development of the following technologies will be promoted through advancement in intelligent transport systems: a) further advanced traffic safety and anti-congestion technologies, b) road traffic information integration and distribution technologies, c) traffic control technologies, and d) convenience improvement technologies. Through these activities, improvements will be made in prompt delivery of information and related support pertaining to the traffic safety for both pedestrians and drivers, in alleviation of traffic congestions, and in transport convenience. As a result, the safest and most convenient road traffic

systems in the world will be materialized, while aiming at reducing traffic accident casualties to zero. Additionally, development of advanced technologies will also be promoted for other traffic systems such as the railway system.

[CAS, National Police Agency (NPA), MIC, METI, MLIT]

2. Main Measures toward Social Implementation

- Establishment of frameworks (e.g., legal systems) for promoting practical application and diffusion of technologies developed

[CAS, NPA, MIC, METI, MLIT]

- Activities toward international standardization and international expansion from the technology development stages

[CAS, NPA, MIC, MOFA, METI, MLIT]

3. Goals to Be Achieved by 2030

- Realization of society with safe, secure, and convenient traffic systems

(4) Realizing the base for next-generation infrastructures

[Roadmap Next-Generation Infrastructure (4)]

1. Details

Development of the next-generation infrastructure will be promoted, such as energy, traffic and logistics systems, telecommunications, water supply, medical care, and environment preservation. Development of information and communication technologies will also be promoted, such as big-data technologies to fully utilize such infrastructure information and security technologies. Additionally, development of integration systems will be promoted in order to interlink various different infrastructures. Through these activities, various infrastructures will be organically and efficiently interlinked, allowing smooth distribution and circulation of data and information. By taking account of the latent needs by the general public and companies, it is anticipated that the QOL of the general public will be improved and the economic activities of companies will be promoted. As a result, a society will be materialized where people can sense safety, security, and affluence in their life.

[CAS, NPA, MIC, MEXT, Ministry of Health, Labor and Welfare (MHLW), MAFF, METI, MLIT, MOE]

2. Main Measures toward Social Implementation

- Activities toward international standardization and international expansion from the technology development stages

[NPA, MIC, MOFA, MHLW, MAFF, METI, MLIT, MOE]

3. Goals to Be Achieved by 2030

- Creation of relevant 10-trillion-yen-scale markets by 2020, through utilizing big data, etc.

IV. REGIONAL REVITALIZATION TAKING ADVANTAGE OF THE REGIONAL RESOURCES

1. BASIC UNDERSTANDING

In order for Japan to maintain sustainable and progressive competitiveness in the global market, it is essential to revitalize local economies by utilizing the potential vitality and resources of the local communities.

However, lately, local communities have been facing various problems such as depopulation, aging, a reduction in employment opportunities due to depression in local economies and local industries, and submergence into the trend of nationwide normalization without being able to utilize their own “strengths.”

Therefore, it is now required for Japan to focus on various resources of local communities and convert them into “assets” (i.e., “strengths”) of the community, by increasing the added value of such resources through, for instance, combining them with other resources.

For revitalization of local communities, science, technology and innovation is tasked to materialize the development of services, products, and production technologies by utilizing local characteristics, through demonstrations of advanced projects, businesses, and business models. Additionally, by aiming at overseas markets, it is anticipated that revitalized local communities will attract globally flowing people, products, money, and intelligence.

2. FOCUSED POLICY CHALLENGES

Among local societies, the societies whose main base industries are agriculture, forestry, and fishery are specifically facing problems such as depopulation, aging, and a reduction in employment opportunities, and measures to resolve these problems are required. To respond to such requirements, the strengthening of agriculture, forestry, and fishery industries through science, technology and innovation is an urgent issue. The potential plans are to develop new food products by utilizing innovative breeding technologies that take advantage of the most

advanced genome researches or by utilizing the functional ingredients of local agriculture and fishery products, and to promote advancement of production systems by utilizing IT. Such activities will allow branding of local products and creation of new products and industries through taking advantage of the local characteristics. As a result, the local economy will be revitalized and will exhibit presence in the global market. Therefore, “reinforcing agriculture, forestry and fisheries through the utilization of science, technology and innovation” is set as a focused policy challenge.

It is also important to realize the revitalization of various local businesses, especially the service industry. To achieve that, new innovations will be brought to the local production industries by combining various local resources with technologies of local industries and small business, or by combining these local resources with innovative production technologies (e.g., 3D modeling) suitable for production of high-mix, low-volume, and high-value products and components. Optimization of local business models will also be conducted by incorporating the know-how of service engineering, etc. Furthermore, it is essential that such activities are promoted under the framework where the industry, academia, and government work in collaboration. Therefore, “developing mechanisms for the creation of innovation coming from regions” is set as a focused policy challenge.

Regional Revitalization Taking Advantage of the Regional Resources

Focused Policy Challenge	Focused Measure
Reinforcing agriculture, forestry and fisheries through the utilization of science, technology and innovation	(1) Sophisticating agriculture, forestry and fishery by utilizing genomic information
	(2) Developing highly-functional and highly-value added agricultural, forestry, and fishery products through the collaboration with medicine
	(3) Sophisticating production system of agriculture, forestry and fishery products by IT and robotic technologies.
Developing mechanisms for the creation of innovation coming from regions	(4) Nurturing industrial competitiveness through the utilization of producing technology
	(5) Promoting local business by service engineering
	(6) R&D and measures for activating local economy through industry-academia-government collaboration in the regions

(1) Sophisticating agriculture, forestry and fishery by utilizing genomic information

[Roadmap **Local Resources (1)**]

1. Details

This aims at accelerating the development of new innovative species that contribute to product development and branding in local communities. For that purpose, the following activities will be promoted: a) genome analysis and metabolite analysis of the important crops, etc.; b) establishment of an information infrastructure (e.g., database); c) identification of useful genes; d) development of DNA markers; e) utilization of bioinformatics for the development of techniques to improve important characteristics, where various genes are involved; f) utilization of bioinformatics for the development of techniques that allow quick identification of useful genes; g) development of breeding technologies, which greatly improves the producing efficiency of new species, etc., and so on. Through these activities, globally expanding advanced agriculture, forestry, and fishery industries will be realized, resulting in the materialization of active local societies.

[MOFA, MEXT, MAFF]

2. Main measures toward social implementation

- Strengthening of cooperation structure for researches from companies, universities, research and development institutions, and public research and development institutes on thremmatology, pest science, quality science, cultivation physiology, molecular biology, bioinformatics, etc.

[MEXT, MAFF]

- Strategic utilization and protection of intellectual properties pertaining to new species

[MAFF]

3. Goals to be achieved by 2030

- Acceleration in cultivation of new species
- Improvement in productivity in the agriculture, forestry, and fishery industries

(2) Developing highly-functional and highly-value added agricultural, forestry, and fishery products through the collaboration with medicine

[Roadmap **Local Resources (2)**]

1. Details

Creation of database for functional ingredients in agriculture, forestry, or fishery products, and development of health-promoting functional foods (agro-medical foods) will be promoted. Safety and effectiveness evaluation of those products aiming at practical application, and development of medical supplies and new medical materials, etc., by utilizing agricultural products will also be conducted. Additionally, as a method for preventing illness and diseases, a supply system of foods, etc., in accordance with the individual's health conditions (tailor-made system) will be established in collaboration with medicine. Furthermore, highly precise, highly effective cultivation systems will be developed in order to secure improvement and consistency in the amount, etc., of the functional ingredients in products such as foods, medical supplies, and cosmetics. The cultivation systems will possess functions to precisely and quickly evaluate the quality of the products by utilizing plant factories, IT, etc. Through these activities, a society will be materialized where new industries are created by utilizing functions of agriculture, forestry, and fishery products.

[CAS, MOFA, MEXT, MHLW, MAFF, METI]

2. Main measures toward social implementation

- Support for safety and effectiveness evaluation targeting approval by the Pharmaceutical Affairs Act, in order to realize manufacture and sale of medical supplies and devices

[MHLW, MAFF, METI]

- Establishment of a system to conduct large-scale epidemiological studies (e.g., cohort studies) in collaboration with preventive medicine

[MEXT, MHLW, MAFF]

- Establishment and industrialization of a supply system of foods, etc., in accordance with the individual's health conditions (tailor-made system)

[MHLW, MAFF]

3. Goals to be achieved by 2030

- Creation of a new market centering on functional agriculture, forestry, and fishery products

(3) Sophisticating production system of agriculture, forestry and fishery products by IT and robotic technologies [Roadmap Local Resources (3)]

1. Details

This aims at labor saving and efficiency increase in farm works by introducing engineering technologies such as IT and robots into various work phases. The work phases include management of farm fields and products, harvesting, and grazing management of livestock. Ubiquitous environmental control system, etc., will also be utilized to realize energy saving, stable production, etc., of high-quality agricultural products. Additionally, in order to address the inheritance problems of agriculture, forestry, and fishery industry technologies, the craftsmanship and know-how (i.e., implicit knowledge) of these industries will be converted into explicit knowledge through computerization and standardization through utilizing agri-informatics (AI). Such explicit information will be utilized for yield forecast and management support, in order to establish high-yield, high-profit farming models. Regeneration of the forestry industry will be achieved by development in production and distribution systems through smartization and authentication of timber productions, considering the public benefits of forests, and by improving the efficiency in lumbering and other production processes of wood-based materials. Additionally, in order to contribute to the worldwide food problem, large-scale complete aquaculture systems (therefore not relying on natural fry) will be developed for eels, tuna, etc., through advancement in breeding environment control systems, etc. Through these activities, a society with easy-to-work sustainable agriculture, forestry, and fishery industries will be realized.

[CAS, MIC, MOFA, MEXT, MAFF, METI]

2. Main measures toward social implementation

- Systems for conducting large-scale demonstration such as introduction of IT, robots

[MIC, MAFF, MLIT]

- Arrangement related to intellectual properties and consideration for international standardization pertaining to know-how that was converted to explicit information by AI

[MIC, MOFA, MAFF, METI]

- Acceleration of EU HACCP approval process for Japan's fishery products' manufacture and processing facilities, which is one of the export barriers for Japanese fishery products to EU countries

[MHLW, MAFF]

3. Goals to be achieved by 2030

- Major reduction in labor costs and workload, and improvement in productivity

(4) Nurturing industrial competitiveness through the utilization of producing technology **[Roadmap Local Resources (4)]**

1. Details

Strengthening industrial competitiveness of local communities will be promoted by linking local resources to technologies of Japan's backbone industries such as manufacturing. For instance, advanced production technologies (e.g., 3D modeling) that facilitate utilization of intelligence and the sense of small businesses and individuals will be applied to local manufacturing industries. These activities will promote generation of innovations in the development processes, resulting in creation of high-mix, low-volume, and high-value local products and services. Through these activities, active local economies that utilize advanced IT and production technologies will be realized.

[MIC, MOFA, MEXT, MHLW, MAFF, METI]

2. Main measures toward social implementation

- Creation of opportunities to learn innovative technologies for small and medium enterprises, individual entrepreneurs, and citizens with entrepreneurial motivation

[MIC, MEXT, MHLW, MAFF, METI]

3. Goals to be achieved by 2030

- Implementation of flexible manufacturing of high-mix, low-volume products, and establishment as local industries

(5) Promoting local business by service engineering **[Roadmap Local Resources (5)]**

1. Details

Various local resources will be combined with the know-how of "service engineering." Through fully utilizing IT, service engineering collects and analyzes data from the work sites of service business, establishes optimal business models, and applies the models to the work sites. Through these activities, active local economies that utilize advanced IT and production technologies will be materialized.

[MIC, MOFA, MEXT, MHLW, MAFF, METI, MLIT]

2. Main measures toward social implementation

- Support for matching the local talents to the specialists of new technologies such as “service engineering”

[MIC, MEXT, MHLW, MAFF, METI, MLIT]

- Research and development projects related to collection and analysis of large-scale data

[MIC, MEXT, MHLW, MAFF, METI, MLIT]

- Standardization of benchmarking methodologies for evaluating the quality and efficiency of services and service provisions

[METI]

3. Goals to be achieved by 2030

- Materialization of promotion of local industries and revitalization of local economies through development of new services and products achieved by generating new values by utilizing service engineering, etc.

(6) R&D and measures for activating local economy through industry-academia-government collaboration in the regions

[Roadmap **Local Resources (6)**]

1. Details

Development of local industries will be promoted by utilizing world’s best or one-of-a-kind technologies of local companies and the scientific knowledge, technologies, and facilities of universities and research institutes. To achieve that, the industry, academia, and government will work in collaboration. Additionally, activities toward generating innovations that lead to creation of new industries will be promoted. Examples are creation of new local industries and application of existing local technologies to other fields by utilizing intellectual properties of universities, research institutes, technology licensing organizations, etc. Through these activities, active local economies that fully utilize local “strengths” will be materialized.

[CAO, MIC, MOFA, Ministry of Finance (MOF), MEXT, MHLW, MAFF, METI, MLIT, MOE]

2. Goals to be achieved by 2030

- Contribution to Japan’s economic growth by realization of local innovations by the industry, academia, and government working in collaboration

V. EARLY RECOVERY AND REVITALIZATION FROM THE GREAT EAST JAPAN EARTHQUAKE

1. BASIC UNDERSTANDING

The Great East Japan Earthquake was an unprecedented catastrophe where a large-scale earthquake and tsunami devastated Japan. It also caused an incident at a nuclear power station, which resulted in release of radioactive materials, threatening the surrounding environment. The impact of the earthquake engulfed Japan's whole society and economy as well as those of the disaster-affected areas. One of Japan's most urgent tasks is to recover from the Great East Japan Earthquake and rebuild people's living and the industries as early as possible. Two years have passed since the earthquake, and the Japanese people strongly desire acceleration of the reconstruction and recovery process.

Japan is going to consider the reconstruction and recovery as an opportunity for further development of the nation by taking advantage of the lessons learnt from the earthquake. It is important to utilize every achievement of cutting-edge science, technology and innovation and to work in collaboration with the activities for the focus areas I–IV described in Chapter 2, so that the disaster-affected areas turn into "places of possibilities and new creations."

2. FOCUSED POLICY CHALLENGES

It is essential to widely and quickly address existing issues in order to achieve early reconstruction and recovery of the disaster-affected areas. Therefore, the following five issues are set as focused policy challenges:

- (1) Realizing a society where residents' health are protected from disasters and children and the elderly people are sound and healthy
- (2) Establishing energy system resilient against disasters
- (3) Developing new business models in local industries
- (4) Establishing next generation infrastructures resilient against disasters
- (5) Mitigating and resolving influences by radioactive material

In conducting activities for the focused policy challenges, short-term issues will be promptly addressed and the relevant achievements will be utilized for reconstruction and recovery of the disaster-affected areas, in order to accelerate the reconstruction and recovery process. The medium- to long-term issues will be addressed accordingly and the relevant achievements will be utilized for reconstruction and recovery as necessary. Furthermore, by propagating the achievements and their

utilization cases to the whole nation and to the world, it is anticipated that the disaster-affected areas become model societies of the world.

Early Reconstruction and Recovery from the Great East Japan Earthquake

Focused Policy Challenge	Focused Measure
(1) Realizing a society where residents' health are protected from disasters and children and the elderly people are sound and healthy	Developing medical technology, R&D on proper methods of medical provision and health maintenance, R&D on how to properly support those vulnerable in disasters including expecting and nursing mothers, infants and elderly people in the event of disasters
(2) Establishing energy system resilient against disasters	Developing renewable energy in consideration of climates and characteristics of the regions
(3) Developing new business models in local industries	Reinforcing industrial competitiveness and job creation through the utilization of innovative technology and local strength
(4) Establishing next generation infrastructures resilient against disasters	Expediting the transmission of information on the occurrence of tsunamis and earthquakes, improving the resilience of structures, disposal and effective use of massive disaster wastes
(5) Mitigating and resolving influences by radioactive material	Effectively and efficiently decontaminating and disposing of radioactive materials, preventing exposure of workers engaging in decontamination

3. FOCUSED MEASURES [Appendix: Roadmap **Reconstruction and Recovery**]

(1) Realizing a society where residents' health are protected from disasters and children and the elderly people are sound and healthy

[Roadmap **Reconstruction and Recovery (1)**]

1. Details

Researches are promoted for short-term to medium- to long-term disaster medical technologies based on the experiences gained from the earthquake. Disaster medical technologies include methods to appropriately provide the victims with medical care and to maintain their health in accordance with their constantly monitored health conditions, and methods to appropriately provide support for

those weak in disaster, such as expectant and nursing mothers, infants, and elderly people. These activities will contribute to materializing a society where people's health is protected from disasters and children and elderly people live actively.

[MHLW, MEXT]

2. Main goals

Quick and appropriate provision of medical care to disaster victims and maintenance of their health

- Researches on securing medical care at the time of large scale-disasters

To be implemented in 2015

- Researches on the health conditions of the victims of the Great East Japan Earthquake and on health support at the time of large-scale disasters

To be partially implemented in 2015

(2) Establishing energy system resilient against disasters

[Roadmap **Reconstruction and Recovery (2)**]

1. Details

Development of disaster-resistant technologies, etc., related to renewable energies will be promoted, considering the natural features and characteristics of local areas. These activities will contribute to materializing a society with advanced and sustainable energy systems such as independent and widespread energy systems.

[MIC, MEXT, MOE]

2. Main goals

Next-generation energies for Tohoku Recovery Project

To be partially implemented in 2018

- Research and development of marine renewable energies along the Sanriku coast
- Research and development, etc., of microalgae to be utilized as energy sources

Augmentation of functions for preventing secondary disasters such as fires at industrial facilities

- Improvement in the safety of petroleum tanks and development of sediment fire extinguishing technologies To be implemented in 2018

(3) Developing new business models in local industries

[Roadmap Reconstruction and Recovery (3)]

1. Details

Regeneration of highly competitive agriculture, forestry, and fishery industries will be promoted by developing new business models, through development and implementation of cutting-edge technologies. Strengthening industrial competitiveness of local communities by utilizing novel technologies and local “strengths” will also be promoted. These activities will contribute to the creation and expansion of job opportunities and recovery of the industries in disaster-affected areas.

[MEXT, MAFF, METI]

2. Main goals

Regeneration of highly competitive agriculture, forestry, and fishery industries

- Implementation of new technology systems (combination of various cutting-edge technologies) to disaster-affected areas To be diffused in 2018

Creation and expansion of job opportunities in disaster-affected areas by strengthening industrial competitiveness of local communities conducted by utilization of novel technologies and local “strengths”

- Development of high-efficiency rare element extraction technologies, ultra-low core loss magnetic material technologies, ultra-low friction technologies To be implemented in 2018

(4) Establishing next generation infrastructures resilient against disasters

[Roadmap Reconstruction and Recovery (4)]

1. Details

Development of the following technologies will be promoted: a) lower-cost anti-liquefaction technologies, b) creation of a society that mitigates damage from tsunami, c) technologies to improve the resilience of the constructions against disasters, d) technologies to process and utilize large-scale disaster wastes, e) technologies to promptly and accurately acquire and distribute earthquake and tsunami information for prompt evacuations, f) technologies related to lifesaving at

the time of disasters, and g) technologies to improve the resilience of logistics systems and information infrastructure. These activities will contribute to creating local communities that are safe and secure against disasters.

[MIC, MEXT, MLIT, MOE]

2. Main goals

Further cost-effective prevention of liquefaction

- Development of lower-cost urban area anti-liquefaction technologies
To be implemented in 2018

Reduction of tsunami damage in towns by reflecting the geographical conditions on placement and designing

- Development of technologies to increase the accuracy and efficiency of crustal movement observations in the Pacific Ocean off the coast of Tohoku region
To be implemented in 2019

Improvement of the resilience of the constructions against disasters

- Development of breakwater structures that are resilient against tsunami
To be implemented in 2015

Swift and smooth processing or utilization of large-scale disaster wastes

- Development of management and processing systems of disaster wastes
To be implemented in 2015

Accurate acquisition of earthquake information and its prompt and appropriate distribution

- Improvement in prediction accuracy of earthquake early warning
To be implemented in 2015

Swift and accurate acquisition of tsunami information

- Advancement in tsunami prediction information To be implemented in 2015

Preparation and provision of information for conducting evacuations swiftly and appropriately

- Advancement in earthquake and tsunami simulations
To be implemented in 2018

Swift and reliable lifesaving activities at the disaster sites

- Development of fire engines, etc., that enable traveling and lifesaving in areas filled with rubble and/or water To be implemented in 2018

Establishment of base technologies for securing resilient logistics systems that function rapidly and appropriately

- Development of systems for utilizing high-resolution observation data obtained by the Advanced Land Observation Satellite-2 To be implemented in 2015

Acquisition of necessary data, securing resilience of communication methods

- Development of synthetic aperture radar that can be mounted on small airplanes To be implemented in 2015

(5) Mitigating and resolving influences by radioactive material

[Roadmap Reconstruction and Recovery (5)]

1. Details

This aims at reduction and dissolution of effects arising from radioactive materials released due to the incident at the nuclear power station. For that purpose, technology development will be promoted for research studies on health-related issues, prevention of exposure to decontamination workers, etc., effective and efficient decontamination and disposal of radioactive materials, and measurement, evaluation, and decontamination of agriculture and fishery products.

[MEXT, MHLW, MAFF, MOE]

2. Main goals

Relief of residents' anxiety on health effects of radioactive materials

- Development and field tests of radiation meters, etc., for detecting hot spots To be implemented in 2015

Prevention of exposure to decontamination workers, etc.

- Development of methods that enable efficient and swift radiodensity measurement operations To be implemented in 2015

Effective and efficient decontamination and disposal of radioactive materials

- Development of effective and efficient adsorbing and stabilizing materials To be implemented in 2015

Swift measurement and evaluation of radioactive materials in agriculture and fishery products and industry products, swift decontamination of the products, and securing the distribution of the products

- Development of techniques for monitoring radioactive materials in foods
To be implemented (at all times) in 2015

CHAPTER 3 CREATING ENVIRONMENT SUITED FOR SCIENCE, TECHNOLOGY AND INNOVATION

1. BASIC UNDERSTANDING

As described in Chapter 1, “An innovation-friendly country” is a country where numerous and various innovation leaders reside and a framework is established for them to fully utilize their abilities. The very base of innovations is human; innovations require many people to play various roles, such as creation; diffusion and application of intelligence; augmentation and innovation of the existing industries; and creation of new industries. Pioneering innovations also require plenty of opportunities and chances, while the whole society positively allows taking risks and accepts costs involved. It is important to create such an innovation-facilitating environment for the future of Japan.

Needless to say, development of human resources to produce innovation leaders is important, and further improvement in education is desired in order to develop the international competitiveness of such talents in line with the needs of the economic society. Japan has already produced various talents, and thus this chapter will introduce policies for establishing a framework that facilitates generation of innovations.

The first thing required for creating an environment suited for science, technology and innovation is to “grow innovation seeds.” In order to achieve that, Japan will strongly promote various innovative world-class basic researches at universities and research institutes where innovation leaders fully demonstrate their abilities. Japan will also strongly promote research and development (R&D) of national security technologies and core technologies as the foundations of the nation. Universities and research institutes will be required to voluntarily reconstruct and revitalize their management systems and resource utilization methods, so that the whole society system will be able to facilitate the generation of innovation seeds.

The second requirement is to “drive the innovation system.” Innovations require various talents: people who plant innovation seeds, people who grow the seeds, people who industrialize the harvests, people who support innovation creation, and people who produce the whole innovation process. It is vitally important to establish an environment that enables these talents to drive the innovation system by leading each stage of innovation and by linking the individual innovation stages.

The last requirement is to “fructify the innovations.” It is essential to establish an environment that continuously creates values through innovations, for instance, by removing bottlenecks in the implementation and industrialization of innovations.

In order to create an environment suited for science and technology, it is necessary to identify and resolve the bottlenecks dwelling in Japan’s organizations and systems, and dare to break the existing conventions and customs. In the present chapter, focused policy challenges and activities for creating an environment suited for science, technology and innovation will be clarified from this point of view.

The focused policy challenges and activities shown in the present chapter aim at enhancing the effectiveness of the issue-resolving activities for the economic society described in the preceding chapter as well as establishing the basis for swift innovation creations.

2. FOCUSED POLICY CHALLENGES

In order to create an environment suited for science, technology and innovation, “nurturing the sprouts of innovations,” “activating the innovation system,” and “fructifying innovations” are set as focused policy challenges, and the following activities are set as focused measures for the focused policy challenges.

Creating an Environment Suited for Science, Technology and Innovation

Focused Policy Challenge	Focused Measure
Nurturing the sprouts of innovations	(1) Establishing an environment which enables diverse people to take the leadership in enterprises, universities and R&D corporations
	(2) Reinforcing universities and R&D corporations as international hubs
	(3) Restructuring systems of competitive funds
Activating the innovation system	(4) Reinforcing industry-academia-government collaboration and inter-ministry collaboration
	(5) Promoting mobility of human resources
	(6) Improving research support system
Fructifying innovations	(7) Activating private enterprises engaging in new projects
	(8) Promoting regulatory reform
	(9) Reinforcing the strategies for international standardization and IP

3. FOCUSED MEASURES

(1) Establishing an environment which enables diverse people to take the leadership in enterprises, universities and R&D corporations

1. Details

Innovation generation requires bold thinking. Such thinking often arises from autonomous friendly competition among various talents including young, female, and foreign researchers. Therefore, it is necessary to establish a research environment where such talents can provide leadership. Specifically, the following courses of action will be the principles:

- Employment of talents at companies, universities, and R&D corporations with setting a high value on diversity, from the viewpoint of enhancing innovation potentials
- Establishment of fair and clear evaluation systems and research environment, so that young talents can envisage medium-term future plans, and autonomously and proactively conduct researches without being entrapped within the existing field or organizational boundaries
- Promotion of employment and interchange of foreign engineers and researchers

2. Main policies

- Review of regulations for enabling introduction of annual salary systems and mixed salary systems of multiple institutions on the premise that individual performance evaluations will be conducted; review of regulations for enabling accumulation of severance pay (for encouraging employment of home and abroad talents through introduction of flexible personnel and salary systems for universities and R&D corporations)

[MEXT, Ministries that hold jurisdiction over R&D corporations]

- Establishment of systems for securing steady employment and fluidity of young researchers by forming university consortiums

[MEXT]

- Environmental arrangement for promoting activities of young and female researchers as important leaders of science, technology and innovation (from the viewpoint of ensuring diversity)

[MEXT]

- Review of the annual income criteria pertaining to issuing certificates for highly skilled foreign professionals; review of the points-based preferential system for highly skilled professionals such as reduction of the residence years required for issuing the permanent residency (from the viewpoint of accepting more highly skilled foreign professionals)

[Ministry of Justice (MOJ), METI, MHLW]

(2) Reinforcing universities and R&D corporations as international hubs

1. Details

While emerging countries increase their presence in the world, Japan's international superiority in the R&D field is receding. Japan will use the sense of crisis as the driving force to renovate its research environment, so that Japanese universities and R&D corporations will again become highly internationally competitive and become the base of innovation creations in the world. Through that, Japan's centripetal force will be increased for world-class researchers, etc., including Japanese researchers currently working abroad, and Japan will become the 'node' for various innovations. Specifically, the following courses of action will be the principles of the present measure:

- Universities: Promotion of strategic introduction of the resources, by top management, to the areas with distinguished characteristics, distinguished performances, or international competitiveness, taking account of the diversity of academic fields
- R&D corporations: Reform of the corporation system by taking account of the characteristics (e.g., potential duration, uncertainty, unpredictability, specialty) of each R&D; improvement of functions and resolution of bottlenecks dwelling in the current systems, in order to improve superiority in the international competition environment
- Promotion of development, establishment, and wide utilization of world-class R&D infrastructure (e.g., utilization of supercomputers); establishment of an environment where skilled talents from the industry, academia, and government can attempt to conduct innovative groundbreaking research projects beyond the field or organizational boundaries
- Establishment of an innovation platform that induces serendipity as well as new ideas co-generated by the companies, universities, and R&D corporations through knowledge sharing

2. Main policies

- University-wide reform of personnel and salary systems (Universities: responsible for accountabilities, make progress reports annually. MEXT: strategic distribution of grants according to the progress reports made by universities. Council for Science and Technology Policy: investigation and deliberation of important matters (e.g., funds distribution methods) relevant to advancement in science and technology)

[CAO, MEXT]

- Clarification and execution of commitments made by top management of universities, in order to strengthen research capabilities and international

competitiveness of universities (e.g., strategic introduction of resources into internationally competitive areas, university-wide systematic reform)

[MEXT]

- For R&D corporations, establishment of a new world-class system by relevant ministries working in cooperation, taking into account the structural and organizational reviews of all independent administrative agencies (The new system will be established with efficient operations and accountability to the public as major premises, and will obey the following rules: (1) place the primary target to maximization of R&D results (i.e., accomplishment of missions), (2) systematically clarify the position of R&D corporations as research institutions that tackle the projects based on national strategies where universities and enterprises find difficulties dealing with, (3) legislatively secure the necessity of acquisition of internationally competitive talents, practice of professional evaluations based on internationally acceptable evaluation guidelines, establishment of inquiry commissions related to R&D under the minister in charge (enabling assignment of foreigners), extension of medium-term target periods, and system operation based on the characteristics of R&D, (4) aim at the realization of reviews of pay levels, reviews of the ideal efficiency targets of business operations, improvement in procurement methods, review of the treatment of revenues, flexible carrying-forward of budget, etc.)

[MEXT, CAO, CAS]

- Immediate review of the existing regulatory systems to make improvements in operation

[MEXT, CAO, CAS]

- Relaxation of restrictions pertaining to personnel expenses, in order to promote international brain circulation
- Formulation of procurement standards in accordance with the actual situations in the research field in order to enable flexible contracting and procurement methods (i.e., not limiting to open tendering)
- Removal of revenues (e.g., donations) contributing to promotion of innovation creation from the exclusion list of government subsidies for national university and R&D corporations
- Improved flexibility in carrying the budget over the medium-term target period
- Promotion of system establishment, research results publication, and research results sharing conducted by universities and R&D corporations along with improvement of research-supporting systems (see 3. (6)), in order to establish

world-class R&D infrastructure by expanding utilization of technologies, facilities, and equipment beyond the organizational boundaries

[MEXT, Ministries that hold jurisdiction over R&D corporations]

- Establishment of a research environment attractive to world-class researchers including Japanese researchers working overseas at universities and R&D corporations, based on the globally acknowledged to be successful World Premier International Research Center (WPI) Initiative, etc., which leads to the internationalization of the R&D field (e.g., public appeal for international researchers, use of English as the official language, improvement of the business support department)

[MEXT, Ministries that hold jurisdiction over R&D corporations]

(3) Restructuring systems of competitive funds

1. Details

The competitive funding programs will be reconstructed so that researchers who received competitive funding can concentrate on research activities (which are the sources of innovations) and seamlessly develop research projects from basic researches through to practical applications according to individual progress state. The reconstruction aims at enabling a rough classification of research fields and easy renewal of research projects, while maintaining the programs as easy to understand. Additionally, the Council for Science and Technology Policy will lead policies that may induce high-risk, high-impact researches in order to generate the seeds of novel groundbreaking innovations.

2. Main policies

- Improvement of the competitive funding programs conducted by the ministries in terms of the programs' usability and coherence in management; establishment of an ideal funding system beyond the boundaries of the ministries and systems, which enables providing promising researches with continuous funding from basic researches through to applications

[CAO, Ministries that hold jurisdiction over the competitive funding programs]

- Review of the institutional design (e.g., screening methods) of the competitive funding programs so that high-risk, high-impact researches will be promoted and outcomes of industry–academia cooperation will be improved (countermeasure against the decline in the indices of the quality and quantity of scientific papers)

[CAO, Ministries that hold jurisdiction over the competitive funding programs]

- Inspection and analysis of the Scientific Research Grant Program (SRGP) including its institutional design (e.g., relationships between the allocated amount of the grant and the quality of papers, evaluation methods in accordance with the characteristics of research fields); reconsideration of an ideal grant allocation system based on the results of the said inspection and analysis and the significance and effectiveness of SRGP (for fulfilling the external accountability of SRGP, which is the core source (60%) of all competitive funding)

[MEXT]

- Continuous efforts on securing 30% indirect costs for any competitive research funding program for universities, etc.

[CAO, Relevant ministries]

- New developments in successor policies of the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program)

[CAO]

(4) Reinforcing industry-academia-government collaboration and inter-ministry collaboration

1. Details

In order to constantly generate innovations, it is important for the industry, academia, and government to clearly identify their fundamental roles and utilize the complementarities through collaboration. The main role of the universities and R&D corporations is to develop human resources and innovation seeds and hand them over to the industry. The main role of the industry is to fructify innovation seeds in forms of practical application and industrialization. The main roles of the government are to secure the bases of intellectual and human resources, to remove institutional bottlenecks, which are preventing innovations from growing, and to address new social issues arising from advancement in technology. Through realizing such roles, the industry, academia, and government are required to enhance their collaboration in order to make Japan's whole innovation system function smoothly. Additionally, the government will promote the Science, Technology and Innovation policies by all ministries working as a team under the direction of the Council for Science and Technology Policy. Furthermore, the industry and academia will participate in the policies from the strategy formulation stage and commit to the realization of the strategy. As a result, drastic improvement in collaborations among the industry, academia, and government and that among the ministries will be achieved.

2. Main policies

- Implementation of general coordination programs beyond the boundaries of the ministries, in order to materialize information sharing from the R&D planning stages, priority setting of the budget, and swift transition from basic researches through to fructification

[CAO, Relevant ministries]

- Creation of the model bases for evaluation of industry–academia cooperation activities; promotion of further utilization of evaluation indices; promotion of activities toward intelligence cultivation and practical application through voluntary PDCA circulation (e.g., utilization of evaluation indices) by the universities, technology licensing organizations, etc.

[METI, MEXT]

- Active introduction and expansion of education using programs based on the actual needs of the industry, under cooperation between the industry and academia

[MEXT, METI]

(5) Promoting mobility of human resources

1. Details

Innovation-inducing novel ideas and ingenuity often arise from inspiration and stimulation through exposure to new cultures, new values, and new environment. The present measure aims at deliberately creating opportunities of such stimulating experiences and promoting circulation of innovative talents. Specifically, the following courses of action will be the principles of the present measure:

- Realization of “the right person in the right place” by establishing various career paths
- Removal of factors preventing mobility of human resources among universities, R&D corporations, and companies; promotion of domestic and international brain circulation; establishment of the stages and environment where individuals can fully demonstrate their abilities as the front lines of the world
- Drastic reform of personnel and salary systems of universities and R&D corporations that currently follow the systems established for public officials
- Establishment of an environment that enables foreign researchers and their family members to live easily in Japan

2. Main policies

- Review of regulations for enabling introduction of annual salary systems and mixed salary systems of multiple institutions on the premise that individual performance evaluations will be conducted; review of regulations for enabling accumulation of severance pay (for encouraging promotion of home and abroad talents at universities and R&D corporations)

[MEXT, Ministries that hold jurisdiction over R&D corporations]

- Promotion of industry–academia human-resource exchange through establishment of medium- to long-term internship systems; active promotion of introduction of medium- to long-term internship into university education

[MEXT, METI]

- Establishment of systems for promoting acceptance of returnees' and foreigners' children

[MEXT]

(6) Improving research support system

1. Details

Advancement in science and technology has resulted in complication in research systems, advancement in the research infrastructure, and promotion of cooperation among multiple institutions. Nowadays, conducting research activities requires various research supporters such as engineers and intellectual property experts. The importance of such research supporters is considered to further increase in future. The present measure aims at improving the social recognition and acceptance of such research support jobs, by accrediting them as specialized as researchers. Specifically, the following courses of action will be the principles of the present measure:

- Creation of new job categories through categorization of research support personnel and clarification of required knowledge and skills
- Development of policies for continuingly and stably procuring research support personnel under cooperation by the industry, academia, and government
- Promotion of nationwide networking of research support personnel employed by relevant institutions

2. Main policies

- Improvement in recognition and positioning of relevant job categories by revising relevant documents, etc. (e.g., placing requirements for writing down the names and roles of research supporters and the research support system on submitting applications for competitive funding)

[Ministries that hold jurisdiction over the competitive funding programs]

- Establishment of systems for promoting matching of research support personnel to the needs of the universities

[MEXT]

- Establishment of systems for providing re-skilling opportunities to meet new needs for research support personnel

[MEXT]

- Immediate consideration on inspection and measures for the issues related to implementation, etc., of the revised Labor Contract Act at the universities, etc.; establishment of an ideal situation for the whole education and research system

[CAO, MEXT, MHLW]

(7) Activating private enterprises engaging in new projects

1. Details

Venture companies and SMEs play important roles in the social implementation of R&D achievements. Some venture companies create new businesses, while R&D-oriented venture company plant and grow innovation seeds. However, Japan has no specific social consensus that says new values are created on numerous failures. As a result, Japan lacks entrepreneurship, and new industries or venture companies rarely flourish in Japan. Now, the necessity of open innovation is rising, which involves utilization of various external technologies. Therefore, Japan has to outgrow its self-containment mind-set and take full advantage of cooperation by R&D-oriented venture companies, etc.

Risk money suppliers are the key for revitalizing venture companies, etc. The risk money suppliers are required to possess abilities to judge the technology levels and business potential of the venture companies as well as to provide hands-on support for management and industrialization. Environment will be established where such venture companies and risk money suppliers can smoothly conduct their business activities, and R&D activities are continuously conducted. Specifically, the following courses of action will be the principles:

- Establishment of the system for a smooth supply of risk money
- Environmental arrangement for cultivation and promotion of R&D-oriented venture companies, etc.; environmental arrangement for practical application and industrialization of technologies
- Promotion of utilization of new technology products at the public sector

2. Main policies

- Arrangement of financial intermediation systems for assisting risk money supplies

[Financial Services Agency (FSA)]

- Strengthening of risk money supplies under cooperation by the Innovation Network Corporation of Japan and government financial institutions (e.g., Development Bank of Japan, Shoko Chukin Bank)

[MOF, METI]

- Promotion of R&D support activities according to the needs of venture companies (e.g., promotion of a new system that utilizes judgment abilities and know-how of venture business managers, venture capitalists, venture business guiding experts, venture business support experts, etc.)

[METI, MEXT, MIC]

- Promotion of utilization of technologies existing in the market, by making participation in open innovations (e.g., collaboration with businesses in different fields) a requirement for applying for innovation-oriented national projects

[Relevant ministries]

- Promotion of multistage selection methods to widely adopt proof of concept

[Relevant ministries]

- Establishment of a platform of advanced R&D and demonstration environment where various talents participate, through presenting the policy targets across the ministries, in order to induce innovations

[Relevant ministries]

- Arrangement of investment environment for venture companies (e.g., operational improvement of the angel tax system)

[METI]

- Environmental arrangement for R&D investment and capital investment by private companies (e.g., R&D tax incentives)

[METI, MIC, MEXT, MHLW, MAFF, MLIT, MOE]

- Reform of systems to enable funding by universities, etc., for industrialization, etc., of R&D, including companies that selectively fund for industrialization of R&D and venture support funds created by universities

[MEXT]

- Further utilization of tendering systems where technical capabilities become important (e.g., comprehensive evaluation method), while maintaining transparency and fairness of the tendering

[Relevant ministries]

(8) Promoting regulatory reform

1. Details

R&D and social implementation of their achievements can be promoted by utilization of special zone systems, simplification of procedures, development of laws related to demonstration experiments aiming at social implementation, etc. In order to materialize such promotion activities, it is important to conduct reform of regulations and systems that become bottlenecks to science, technology and innovation creation.

The Council for Science and Technology Policy will strengthen cooperation and collaboration with the Headquarters for Japan's Economic Revitalization and the Regulatory Reform Council, etc., in order to conduct regulatory reform for creation of Science, Technology and Innovation.

2. Main policies

- Promotion of regulatory reform based on discussion in the Regulatory Reform Council, such as:

–Environmental arrangement to accelerate diffusion of next-generation vehicles, etc.

(Review of safety regulations pertaining to restrictions etc. on establishment of hydrogen-filling stations and fuel cell vehicle designing [MIC, METI, MLIT])

- Enhancement of systems to promote regenerative medicine

(Consideration on ideal and logical regulations for practical application of new technology seeds related to regenerative medicine such as iPS cells and cell sheets [MHLW])

- Promotion of regulatory reform pertaining to medical equipment

(Review of certification standards pertaining to medical equipment [MHLW])

- Arrangement of ideal business environment by improving work efficiency and cost-effectiveness of business activities

(Review of regulations related to industrial robots [MHLW])

- Establishment of systems that promote practical application and industrialization of R&D through regulatory reform, based on the results of the Advanced Medical Care Development Zone (Advanced Medical Development Zone: Special zones aimed at enabling pharmaceutical consultations conducted by the regulatory authorities from the early stages and flexible management of research funds, implemented for the period of FY2008–FY2012 with some involvement by the Council for Science and Technology Policy)

[CAO]

(9) Reinforcing the strategies for international standardization and intellectual properties

1. Details

Creation of innovations requires promotion of strategic activities viewing international standardization and treatment of intellectual properties in future, from the moment R&D activities commence. New promising international industries in which Japan can exert its superiority will also require fundamental science and technology established as the common bases of the relevant R&D. Such industries will also require strategic management of intellectual properties including international standardization. Specifically, the following courses of action will be the principles of the present measure:

- Promotion of policy implementation related to international standardization and intellectual properties, acquisition of information on their effects, and

improvement in the policies, conducted by the Council for Science and Technology Policy in cooperation with the Intellectual Property Strategy Headquarters and relevant ministries

- Strategic promotion of activities for international standardization and treatment of intellectual properties pertaining to science, technology and innovation, which is utilized for resolving Japan's economic society issues
- Establishment of intellectual property systems to assist overseas business activities carried out by Japanese companies
- Integration of international standardization into the certification system; flexible certification based on expected performance requirements (e.g., safety, security) for some fields such as advanced technologies (e.g., robots, LED lighting) and infrastructure-related technologies (e.g., smart grid, large-scale wind power generation); improvement and review of the certification system to raise entrepreneurs' willingness to run business in relevant industries

2. Main policies

- Establishment of systems to promote specialized support for intellectual property activities and technology transfer activities of research results conducted at universities

[MEXT]

- Promotion of establishment of an Asia-wide intellectual property system, establishment of base systems for winning intellectual property system competitions among relevant countries (conducted for strengthening own international competitiveness), acceleration of the inspection process by further improving and strengthening Japan's inspection systems including sustenance and acquisition of fixed-term inspectors, fostering and acquisition of global intellectual properties and human resources, activities for preventing technology leakage (e.g., effective management of trade secrets), etc.

[METI]

- Strengthening and sustenance of strategic activities related to international standardization; promotion of strengthening Japan's certification institutions and collaboration with overseas certification institutions in order to establish internationally applicable certification systems

[METI]

4. MAIN TARGETS TO BE ACHIEVED BY 2030

(1) Nurturing the sprouts of innovations

Various talents including young, female, and foreign researchers competing with each other and growing numerous seeds of innovations at universities and public research institutes, turning these institutions into international bases of innovation creations

- Increase the employment rate of female researchers at universities and public research institutes to 30% by 2016¹ for natural science as a whole
- Increase the rate of foreign researchers at world-class universities and R&D corporations to 20% by 2020, and 30% by 2030^{2,3,4}

(2) Activating the innovation system

Radical augmentation of positive chain innovation cycles including cooperation among the industry, academia, and government and that among the ministries

- Double the number of large-scale (no less than 10 million yen) joint researches at universities by 2030⁵
- Double the number of joint researches spanning more than 3 years at universities by 2030⁶
- Double the number of foreign patent applications by universities by 2030⁷

1 24.2% at universities as of FY2009 (investigation by MEXT), 21.2% at R&D corporations as of FY2010 (investigation by CAO). The 3rd Science and Technology Basic Plan set the prospective recruitment target of female researchers at universities and public research institutes for “natural science as a whole to be 25% (science 20%, engineering 15%, agriculture 30%, healthcare 30%).” The 4th Science and Technology Basic Plan stated “the government will promote relevant activities so as to achieve the numerical target for recruitment of female researchers under the 3rd Basic Plan, i.e., 25% for natural science as a whole, and further raise the percentage to 30%. In particular, the government will aim at early achievement of the targets of 20% for physical science, 15% for engineering, and 30% for agriculture, and achievement of the target of 30% for the total of medicine, dentistry, and pharmacy.”

2 For monitoring targets, characteristics, etc., of the research field are to be carefully considered.

3 Prevention of technology outflow, etc., is to be carefully considered.

4 3.9%, averaged over all universities and 34 R&D corporations (results in FY2010).

5 Approximately 700 (results in FY2011).

6 Approximately 1200 (results in FY2011).

7 Approximately 2600 (results in FY2011).

(3) Fructifying innovations

Increase the number of coordinator acceptances at international standardization organizations to 150 by 2020¹

Increase the technology exports to 3 trillion yen by 2020²

5. TOWARD ESTABLISHING "THE MOST INNOVATION-FRIENDLY COUNTRY"

(1) Evaluation and improvement of policies overlooking the whole picture

In order to steadily and surely conduct activities toward establishing the country best suited for innovations, it is necessary to plan and implement policies, evaluate their effects, and review the policies based on the whole picture, rather than conducting partial optimization of each policy.

National universities have been incorporated, resulting in relaxation of government regulations and systems, which may obstruct the creation of a research environment. Now it is necessary to reinforce motivation and support, so that all universities share the sense of urgent need for reformation and autonomously work together on progression of the university-wide reformation.

On evaluation of the effects and review of policies involved with private companies, envisaging the whole picture is currently not available due to lack of information such as actual statistics. Therefore, it is necessary to continually conduct investigation and analysis of innovation creation conditions, obstructing factors, environment, etc., at companies, using methods that also enable international comparisons.

(2) Follow-up by the Council for Science and Technology Policy based on the whole picture

The Council for Science and Technology Policy (CSTP) will investigate the actual situations of funding and activities pertaining to R&D-related activities for innovation creations at relevant ministries, independent administrative agencies, national university corporations, etc. The investigation results will be used for analyzing the progress state of the targets described in the preceding section. CSTP will disclose the investigation and analysis results, and request the relevant ministries to make improvements if necessary. It is important to remember that the targets described in the preceding section are supplementary check items; the primary target is to identify whether improvements are made in the environment

1 78 (results in FY2010).

2 Approximately 2.4 trillion yen (results in FY2011).

for generating innovations. Therefore, CSTP will conduct substantial and formative evaluations, taking account of the actual on-site activities.

CSTP will also conduct international comparisons using various evidences (e.g., the state of innovation creation) in collaboration with international organizations and domestic think tanks. Success stories and ideas from relevant institutions and companies will be gathered in the process.

CSTP will compile annual reports based on the activities above and review the relevant policies accordingly. The annual reports shall contain the progress state and information about existence of obstructions for the focused measures described in Section 3, the state of innovation creation, and analysis and evaluation of the overall progress state of environmental arrangement for science, technology and innovation in Japan. According to the annual reports, CSTP will request the relevant ministries to make improvements if necessary.

CHAPTER 4 REINFORCING HEADQUARTER FUNCTIONS OF THE COUNCIL FOR SCIENCE AND TECHNOLOGY POLICY

1. BASIC UNDERSTANDING

The Council for Science and Technology Policy (CSTP) is the headquarter for Japan's science, technology and innovation policies. In order for CSTP to powerfully propel the policies toward establishing "the most innovation-friendly country," CSTP's headquarter function needs to be drastically improved in terms of its authority and budget.

Based on the records and findings from the past activities conducted by CSTP, the issues below are required to be addressed in the future activities of CSTP:

- (1) In order to accelerate innovation creation, it is required to conduct activities and improve functions for connecting research results to the "exits" (i.e., practical application, industrialization), by pursuing all possible measures (e.g., regulatory reform, special zone system) in addition to the R&D policies.
- (2) CSTP has conducted the formulation of important policies (e.g., the Science and Technology Basic Plan) and overall coordination for budget prioritization (e.g., Priority Judgment on Science and Technology Policies, Action Plans for Science and Technology Priority Measures). However, the follow-up functions (e.g., investigating the progress state, evaluation) for the policy implementation stages were weak. The functions to swiftly siphon on-site information and to swiftly reflect it on policies were also weak.
- (3) There are criticisms on the R&D policies conducted by the relevant ministries, that the targets of the policies (e.g., time of industrialization and implementation, performance requirements, international competitiveness requirements) are not clear, the roles, authority, and responsibility of the relevant policy agencies are not clear, etc. In order to accelerate innovation creation, improvement in these issues needs to be strongly promoted.

CSTP will strengthen the cooperation with other headquarters (e.g., the Headquarters for Japan's Economic Revitalization, the Regulatory Reform Council) to promote science, technology and innovation policies. Also, CSTP will directly promote elimination of silos between ministries, seamless connection from basic researches through to the "exits," and improvement in cooperation by the industry, academia, and government.

CSTP is required to actively commit itself to strengthening activities at respective research stages and for the whole R&D process, increasing the number of innovation creations in Japan, and realizing "the most innovation-friendly country."

Parenthetically, in addition to the reinforcement of headquarter functions of CSTP, there have been discussions on the importance of "Science and Technology Advisors" (tentative name), who advises the Prime Minister, etc., on science,

technology and innovation, in order to fulfill the leadership of the cabinet. This issue is to be discussed further in the future.

2. IMMEDIATE ACTIONS REQUIRED FOR REINFORCING HEADQUARTER FUNCTION OF THE COUNCIL FOR SCIENCE AND TECHNOLOGY POLICY (CSTP)

Unconventional drastic measures are required for CSTP to function as headquarter of Japan's Science, Technology and Innovation policies. In addition to budgetary provision and amendment of relevant laws, any management improvement will have to be immediately adopted. Urgent measures required for drastically strengthening headquarter functions of CSTP are as follows:

(1) Leading the science and technology budget formation

1.Strategic budgeting related to science and technology for the whole government

A new mechanism will be introduced from the FY2014 budget request stage, in order for CSTP to take the lead in strategy related to science and technology for the whole government.

- A) Establish "the Science and Technology Budgeting Strategy Committee" (tentative name) under CSTP, which consists of the senior officials of relevant ministries. The purpose of the committee is to promote innovation creation activities conducted by the industry, academia, and government, through overall coordination of budgeting from the budget request compilation stages. The coordination includes prioritization of R&D projects and budget, and realization of "upstream" through to "downstream" R&D activities.
- B) Improve the budget formation by advancing the existing activities for budget prioritization annually implemented by CSTP (e.g., Action Plans for Science and Technology Priority Measures). This aims for removing duplications and promoting cooperation among policies of relevant ministries, linkage between R&D policies and other policy measures (e.g., regulatory reform, special zone system), implementing PDCA, and introducing a program that integrates policies of relevant ministries (Cross-Ministry Programs). Especially, for formulation of Action Plans for Science and Technology Priority Measures pertaining to the FY2014 budgeting, the roadmap of the Comprehensive Strategy on Science, Technology and Innovation will be further detailed by around July as part of the annual PDCA cycle.

2.Establishment of cross-ministry programs to promote innovation

- A) It is required to create promising markets for the future of Japan's industries and achieve revival of Japan's economy (e.g., sustainable economic growth,

creation of markets and job opportunities) through resolving the nation's priority issues. For this purpose, it is important to conduct cross-ministry activities for generating innovations, while taking into account the activities to be conducted by individual ministries. Such cross-ministry activities require a drastic improvement in the strategy promotion functions of CSTP. As part of this, a new program (Strategic Innovation Creation Program (tentative name)) will be created, where CSTP is able to per se allocate budget across ministries for activities that will contribute to solving the priority issues such as development of key technologies.

B) Framework (scheme)

- a) CSTP will identify the important issues for generating innovations and establish a new cross-ministry program in cooperation with the industry, academia, and ministries. The purpose of the program is to promote R&D, etc., to view the whole innovation process from the basic researches through to the "exits" (i.e., practical application and industrialization). Required budget will be earmarked for the Cabinet Office after the nation's R&D budget is reviewed by the viewpoints of maximizing the efficiency and effects.
- b) The program will be formulated by combining intelligence and wisdom of the industry, academia, and government. Considerations will be made on the practical systems, etc., that enable selection and setting of high-impact research themes (selected by the current state of advanced researches, international standards, and the needs of the industry and society), practice of such researches, and swift linkage of the researches to the "exits."
- c) For the operation of this program, appropriate budget execution systems will be considered according to the content of the program. Examples of execution systems are, 1) the Cabinet Office is to directly execute the operation budget, 2) the budget is to be transferred to relevant ministries and then executed by the ministries, and 3) independent administrative institutions are to be utilized for execution.
- d) Realization of this program requires augmentation of the workforce of the Cabinet Office. CSTP will request relevant ministries and institutions to cooperate in this regard.

3. New developments for succeeding policies of the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program)

- A) The FIRST Program has various characteristics such as concentrated investment, setting up foundations for research funding, and establishment of research support institutions. The medium-term evaluation conducted in March 2013 identified that a majority of 30 research projects covered by the FIRST Program

have produced high-level world-class research results. Future developments of the FIRST Program summarized by the medium-term evaluation are as follows:

- Utilizing the projects funded by the FY2012 supplementary budget and FY2013 budget will be an effective measure for supporting developments of cutting-edge researches (e.g., the Strategic Basic Research Programs by the Japan Science and Technology Agency to support large-scale non-secretive research developments, public–private innovation programs to support practical application of existing research results)
- Sustainable and stable acquisition of research funds is to be realized by utilizing management expenditure grants for R&D corporations. Also, new systems that enable multiple-financial-year contracting (i.e., bearing liabilities with the national treasury funds) and financial-year-based granting of research funds are to be introduced to the Grants-in-Aid for Scientific Research (KAKENHI) in the FY2013 budget. Utilization of such frameworks is considered to be effective for improving the flexibility of the research funds.

(Note) Extracts from the “Medium-Term Evaluation Results of the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program)” (“CSTP Committee for Promoting Support for Advanced Research and Development”, March 7, 2013)

Therefore, steady utilization of the FIRST Program and relevant programs is important for promoting advanced researches in order to improve Japan’s research capabilities.

Also, there have been discussions on the importance of the following support methods for promoting creation of groundbreaking innovations:

- a) Method that swiftly and boldly provides support for high-risk, high-impact innovative researches that are low in certainty yet high in impact on success (DARPA¹ model)
- b) Method that covers handing over of innovations to industrialization (e.g., supply of risk money) by extending the results of the FIRST Program
- c) Method that strengthens the industry–university cooperation through temporary transfers of human resources from universities to the industry, resulting in further promotion of brain circulation

¹ Defense Advanced Research Projects Agency, the US military research agency.

Therefore, from the viewpoint of further promotion of advanced researches, the basis of all R&D activities will be elevated in addition to promoting the projects included in the FY2012 supplementary budget and FY2013 budget. For that purpose, a new program (“Innovative Research and Development Support Program” (tentative name)) will be established as part of the growth strategy, referring to the system of DARPA in the USA. The program will select and boldly promote innovative high-impact researches from a long-term perspective, under the responsibility of authorized program managers. The details of the program will be finalized by the end of August 2013, taking advantage of the strong points in budget execution of the current FIRST Program. It will be reflected in the budget request, etc. Selection of research themes will target on themes that will bring drastic changes to the future image of Japan’s economic society and industries, and many industrial experts will be invited to take part in the selection process. Such prioritized budget allocations to supportive measures and introduction of the ideas for supporting, etc., of innovative researches into the projects included in the FY2012 supplementary budget and FY2013 budget are important for development and quality improvement of future science and technology policies.

For the activities above, it is important for CSTP to steadily play its roles as headquarter on the basis of the activities by relevant ministries, including promotion of necessary activities such as inter-ministry arrangements.

4. Establishment of responsible implementation system of the program

In implementing the program, CSTP will establish a system to conduct progress management. CSTP will take responsibility for the operation of each program.

A) Supervision of programs through program directors (PDs), etc.

In order for CSTP to supervise the programs, CSTP will select PDs and program officers (POs) and empower them with strong management authority. Under supervision by the Council, PDs, etc., will participate in the programs from the planning stages and manage the implementation stages (including evaluations) by leading relevant ministries. PDs, etc., are also responsible for arrangement, etc. (i.e., regulatory reform, demonstration experiments, and utilization of special zones until the issue is resolved) with the relevant ministries in order to accelerate returning of the research results to society in the form of industrialization, etc.

B) Establishment of governing boards

CSTP will establish a governing board for each cross-ministry program (area) in order to establish a system that enables progress state management of the

program through appropriate PDCA cycles. It will also enable improvement and amendment of the program in accordance with the progress state. Governing boards shall consist of industrial, academic, or government experts (e.g., company officials, researchers and engineers, administrative personnel) from each field, and conduct theme setting for realization of innovations, advice on management, evaluation of results, etc.

(2) Reinforcement of the secretariat

1. Reinforcement of the workforce of the secretariat

- A) In order to exert analysis and planning abilities, that CSTP should possess, it is essential to qualitatively and quantitatively strengthen the workforce of its secretariat, which is the very base of such abilities. Strengthening of the workforce will be achieved by opening the secretariat to excellent talents with specialized knowledge (e.g., economic growth, industrial competitiveness, innovations) under the industry–university cooperation. Specifically, introduction of a system will be considered by which researchers can participate in activities at administrative departments, referring to the fellowship program of the American Association for the Advancement of Science.
- B) Activities at CSTP secretariat require both scientific knowledge and administrative skills. Necessary talents will be stably acquired by extending the tenure of staffs seconded from relevant ministries, industries, universities. Such talent acquisition will require addressing personnel issues, and request will be made to seek understanding and cooperation from relevant institutions, industry and academia.

2. Strengthening the investigation and analysis (think tanks) functions

In order for CSTP to conduct detailed planning of science, technology and innovation strategies, etc., it is essential for CSTP to possess investigation and analysis functions so that CSTP can acquire and analyze relevant data and evidences domestically and internationally. Therefore, CSTP will request relevant ministries to cooperate in the reinforcement of, enhancement of, and collaboration with the think tank function of CSTP. CSTP will immediately establish the relationship for collaboration and utilization with relevant institutions (e.g., the Science Council of Japan, the Economic and Social Research Institute, the National Institute of Science and Technology Policy, the Research Institute of Economy, Trade & Industry, Center for Research and Development Strategy of the Japan Science and Technology Agency, the Council on Competitiveness-Nippon Keidanren) as soon as practicable.

(3) Activating CSTP

1. Activating CSTP

CSTP will be activated under the leadership of the Prime Minister, in order for CSTP to take the initiative in implementing the science, technology and innovation policies formulated by CSTP and to actively lead the cooperation activities. In order to accelerate creation of innovations, vitality of the industry will be actively utilized in the operation of CSTP.

2. Regular policy dialogue

In order to permeate the understanding of the government policy and to swiftly and appropriately reflect the on-site situations onto the policies, regular policy dialogue will be scheduled with the senior officials of relevant ministries, presidents of major research fund agencies and research institutions, university presidents, leaders and engineers of the industry.

3. Exertion of CSTP's "comprehensiveness"

In order to exert the "comprehensiveness" of CSTP, cooperation and collaboration with other headquarters related to science and technology innovation will be improved through setting regular information exchange opportunities and conducting joint work group meetings. The headquarters include the IT Strategic Headquarters, Intellectual Property Strategy Headquarters, Headquarters for Ocean Policy, Strategic Headquarters for Space Development, and the Office for Healthcare and Medical Strategy. Exertion of further comprehensiveness of CSTP will be discussed.