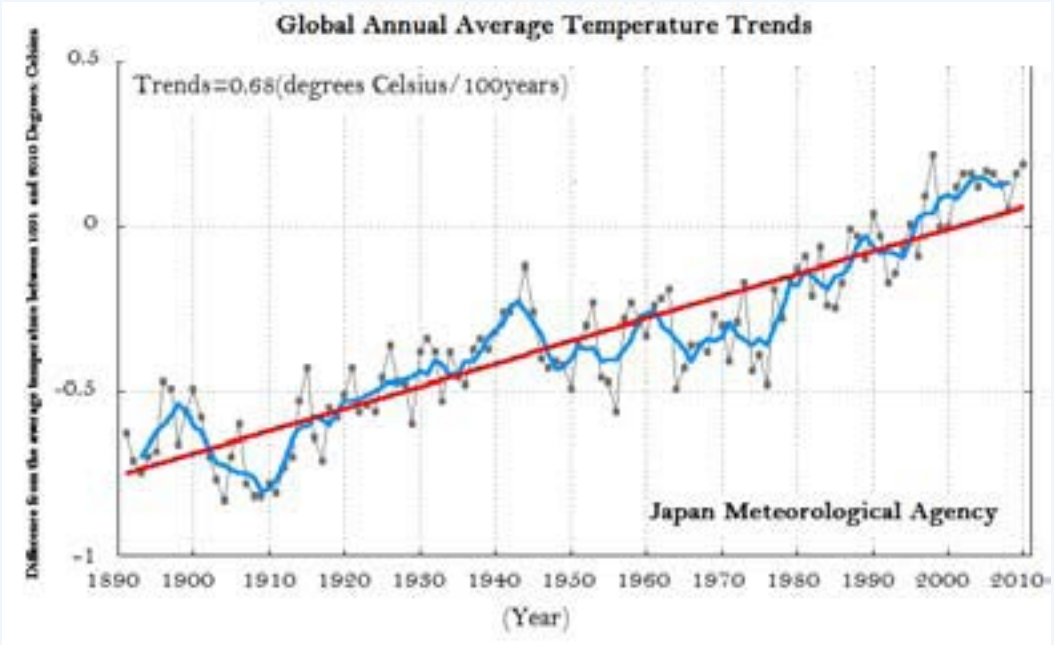
S&T that creates economic value and material wealth is relatively straightforward, but as to what type of S&T will realize spiritual richness demanded by the Japanese public, it is important for the public and the researchers to discover this through communication and construct it together.

2 Various Issues Facing Society

(1) Various Issues in International Society

In international society, global scale issues, such as environmental problems, that should be tackled with cooperation and collaboration by countries throughout the world are becoming ever more serious. For example, looking at the annual average temperatures in the world (the average atmospheric temperature near the surface of landed areas and the sea surface temperature) since the mid-1990s, many years have had high temperatures. 2010 recorded the second highest temperature, after 1998, since records were compiled in 1891 (Figure 1-1-6). Furthermore, in Japan, the average temperature in the summer (June to August) of 2010 was the highest recorded in the 113 years since the start of statistical records in 1898.

Figure 1-1-6/Global Annual Average Temperature Trends



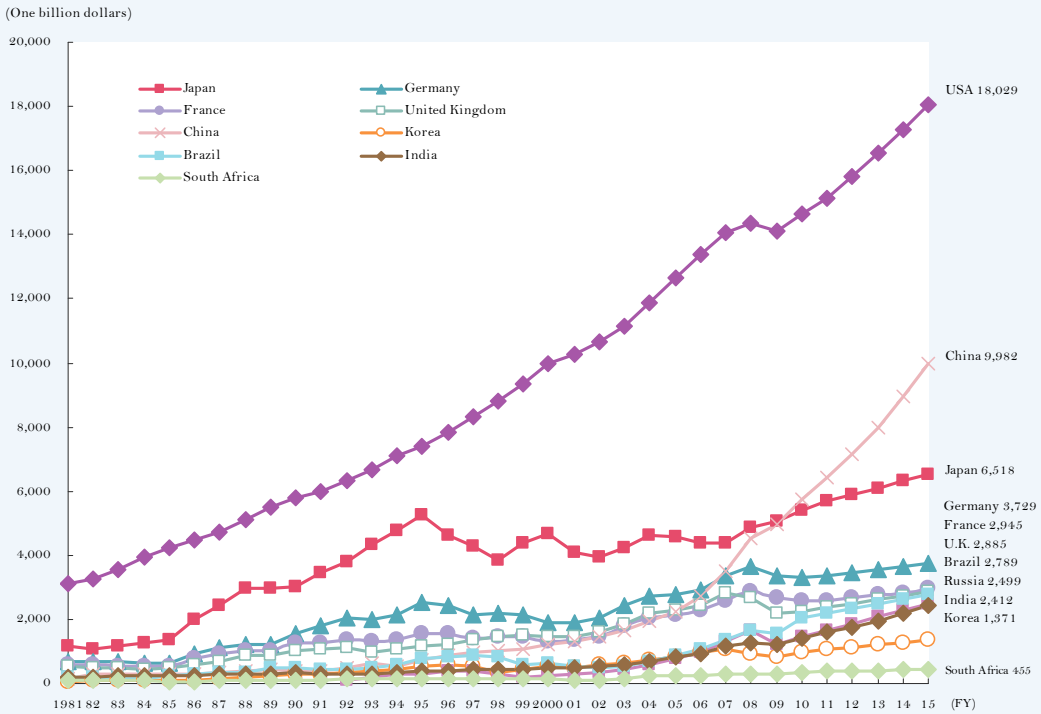
Note: The thin line (black) = the difference from the average between 1981 and 2010 of the average temperature in each year. The thick line (blue): the five year moving average. The straight line (red) = long-term trends.
Source: Created by the Japan Meteorological Agency

On the other hand, international competition is intensifying for the acquisition of resources, energy, food, water and more. This is causing a strain on mid and long-range economic growth in the world and there are fears it may bring about world economic and political instability. Furthermore, along with the economic rise of emerging countries, such as China and India, that possess enormous potential market strength, the global and regional distribution of wealth and power continues to change at a rapid pace (Figure 1-1-7).

For example, with regard to rare metals[1], which are materials indispensible in the manufacturing of high value-added and high function products (e.g. automobile and IT products, such as liquid crystal televisions), their rare and uneven distribution nature is increasing and is susceptible to the export policies of producing countries (Table 1-1-8). In some resource-rich countries, these have been positioned as strategic resources and there are many unstable elements in the environment that surround rare metals, such as the strengthening of state control, e.g. export restrictions. It is concerned that the possibility of tight global supply and supply disruptions in the future.

Because of the further progress in globalization due to the development and spread of information and telecommunications technology and reductions in transportation cost, increased competition in the emerging countries market, and diversification of consumer needs, prompt realization of innovation is getting more and more important. Moreover, global brain circulation[2] is advancing and international competition has become ever fiercer for superior human resources that are the key to science, technology and innovation.

Figure 1-1-7/Gross Domestic Product (GDP) Trends in Countries including Major Countries



Note: The figures after FY 2009 are estimates by the IMF.
Source: Created by MEXT based on the IMF, "World Economic Outlook Database, October 2010"

1 In Japan, rare metals are defined as "Those that from metals of which the amount in existence in the world is rare or for technological and economic reasons are difficult to extract, and that there will be demand for them in the future and it is expected that there will be new industrial demand in line with future technological innovation" (The Rare Metals Subcommittee, the Mining Industry Council). There are 31 types of ore that are covered by this.

2 This is the cross-border circulation of advanced intellectual workers.

Table 1-1-8/Top Producing Countries of Major Rare Metal Resources (Mineral Ore)

	Top producing countries of resources (mineral ore) and production share (2009)						Total share of top producing countries
Rare earth	1. China	97%	2. India	2%	3. Brazil	0.5%	[99%]
Vanadium	1. China	37%	2. South Africa	35%	3. Russia	26%	[98%]
Tungsten	1. China	81%	2. Russia	4%	3. Canada	3%	[89%]
Molybdenum	1. China	39%	2. USA	25%	3. Chile	16%	[80%]
Platinum	1. South Africa	79%	2. Russia	11%	3. Zimbabwe	3%	[79%]
Indium	1. China	50%	2. Korea	14%	3. Japan	10%	[74%]
Cobalt	1. Congo	40%	2. Russia	10%	3. China	10%	[60%]
Manganese	1. China	25%	2. Australia	17%	3. South Africa	14%	[55%]
Nickel	1. Russia	19%	2. Indonesia	13%	3. Canada	13%	[44%]

Note 1 : These are estimated numbers.
Note 2 : The numbers in the indium production are on a metal basis.
Source : Created by MEXT based on the US Geological Survey (USGS), "Mineral Commodity summaries 2010"

(2) Problems Japan faces in the global society

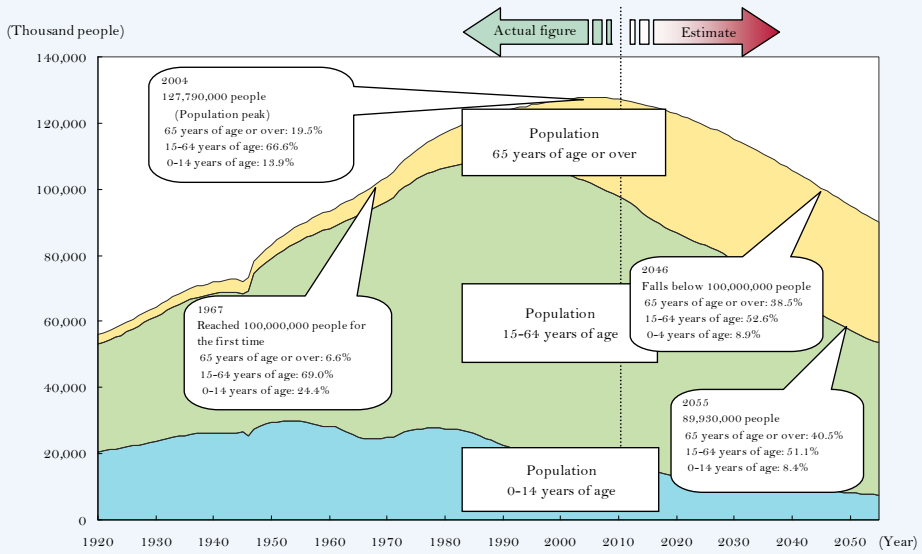
The Japanese government needs to utilize technology actively, in cooperation and collaboration with other countries, to make active contribution to solve the variety of problems that arise on a global scale. At the 16th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 16), which was held from November till December, 2010, they adopted "The Cancun Agreements," encompassing issues such as both advanced countries and developing countries working toward reductions, as a result of negotiations for the prompt construction of an international framework with a single genuinely fair and effective legal binding force, in which all of the major countries, including the USA and China, participate. From here on, the Japanese government has to steadily implement the realization of these agreements and pursue international negotiations for the development of the global framework our country is seeking. In addition, at the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP10)[1] held in Nagoya City, Aichi Prefecture in October, 2010, as the host country, the Japanese government compiled the Nagoya Protocol and Aichi Biodiversity Targets. In the future, in order to make these COP10 efforts real, there will be great expectations placed on our country's leadership.

Domestically, Japan is facing problems that could lead to a further decline in the social and economical energy of an economic situation which has been in a slump for more than 20 years, and what is more, Japan is faced with other serious problems such as an aging population combined with a diminishing number of children and a dwindling population (Figure 1-1-9). While Japan's gross domestic product (GDP) has been making a fairly steady transition in recent years, the global ranking of its nominal GDP per capita is decreasing (Figure 1-1-10). In addition, for the nominal GDP in 2010, rise of China forced Japan to give up the title of "the second largest economy in the world," which Japan had held for 42 years since 1968. Considering the trends of an aging population combined with a diminishing number of children and

1 The Convention on Biological Diversity came into being, along with the Convention to Combat Desertification and the Framework Convention on Climate Change, at the UN Conference on Environment and Development (Earth Summit) held in Rio de Janeiro in 1992. COP(Conference of the Parties) refers to a conference where signatory countries of global conventions assemble, and the COP10 of Convention on Biological Diversity is an abbreviation of the "10th meeting of the Conference of the Parties to the United Nations Conventions Framework on Biological Diversity"

dwindling population, Japan will not be able to avoid a decline in labor power and reduction of the domestic market in the long run, and there is concern that Japan's relative economic ranking in the global society will drop even further.

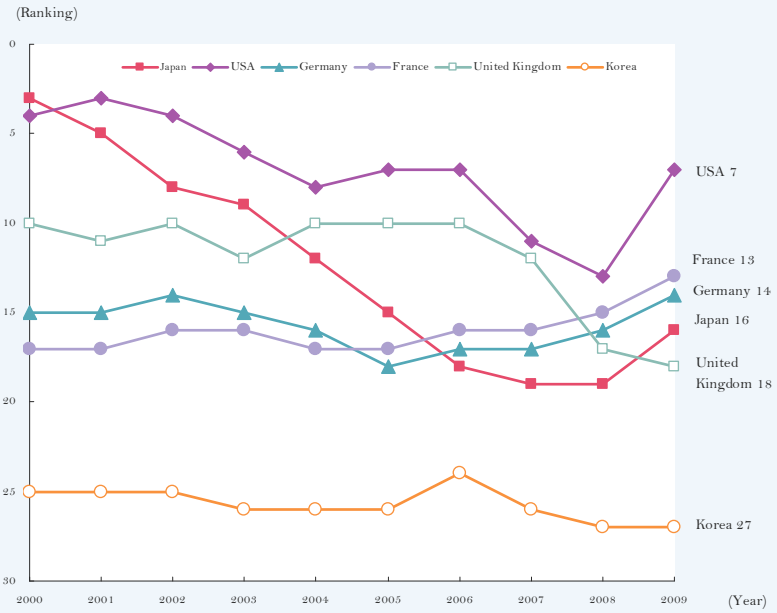
Figure 1-1-9/Change and Outlook of Population Composition by Age Group – Japan: 1920 to 2050



Note： Each population of the three age groups from 1941 to 1943 is interpolated based on the numbers in 1940 and 1944. Okinawa Prefecture was not included for 1945-1971.

Source： Actual figures (1920-2009) are based on MIC's "Population Census," "Population Estimates (estimated population on October 1 each year)," and "1945 Population Survey." Estimated figures (2010-2055) are created by MEXT, based on a moderate-range estimate of "Population Projection for Japan" (December 2006 estimate) by the National Institute of Population and Social Security Research

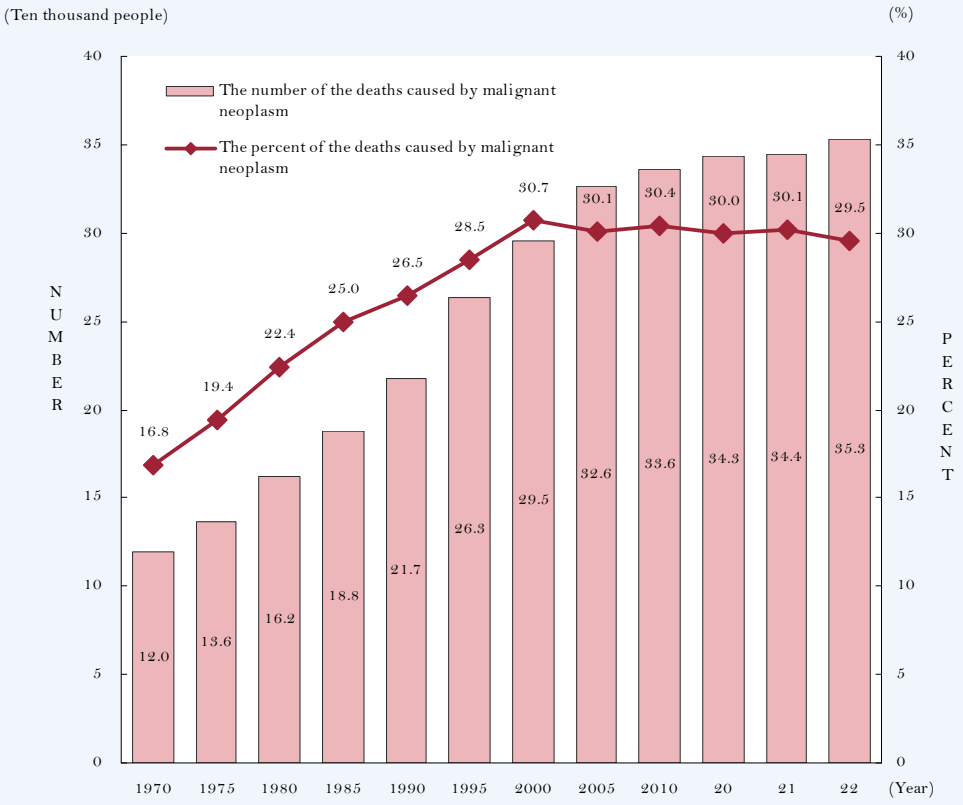
Figure 1-1-10/Transition of Ranking of Nominal GDP Per Capita in Major Countries



Source: Created by MEXT based on "National Accounts for 2009" by the Cabinet Office

In addition to these economic aspects, the Japanese government faces many concerns on the citizens' safety and security maintenance front, such as a decrease in food self-sufficiency ratio and food safety issues, stable water supply, resource and energy security, increasing risk of landslide damage due to torrential rain increasing in recent years, various disasters such as natural disasters like earthquakes and volcanoes, and infectious diseases and illnesses (Figure 1-1-11).

Figure 1-1-11/Number of Deaths Caused by Malignant Neoplasm and Ratio Among All Causes of Death



Note: 1970 did not include Okinawa Prefecture.
Source: Created by MEXT based on "Vital Statistics" by the Ministry of Health, Labor and Welfare

For Japan, where natural resources are scarce, and where the aging population combined with a diminishing number of children is expected to increase along with its dwindling population, S&T, and innovation based on them, could be said to be Japan's only source of competitive edge for the future, and in that sense, could be called Japan's lifeline. However, recently, emerging countries such as China, in addition to the developed countries, have gone ahead with significant expansion of investments for S&T and attempted to develop it as a whole nation, and there are concerns that, even in S&T, Japan's relative position could drop in the future.

In the future, in order to achieve continuous growth, the Japanese government has to strengthen the global competitiveness of industries that support its economic growth, and create and strengthen areas in which added value can be achieved. For this reason, in addition to creating new market through green

innovation and life innovation, the Japanese government needs to further strengthen its manufacturing and promote world-class research and development in foundational areas with high knock-on effects shared with many industries for new industrial infrastructure creation.

Moreover, to ensure that the Japanese public can lead safe, affluent and high quality lives in the future, along with stably securing resources, energy, food and water that are essential in daily life, the Japanese government needs to protect people's lives and property from catastrophic disasters. Furthermore, as well as people's safety, it is also important to promote work for the realization of true abundance, including the improvement of lifestyle convenience and comfort.

To solve these problems that it faces, the Japanese government needs to gain public understanding, confidence, and support, and construct an innovation system that dramatically improves collaboration with society and among the industry-academic-government chain for science, technology and innovation.

[Column 1] The "Shale Gas Revolution" Brought About By The Advancement Of S&T

Shale gas becoming recoverable due to the advancement of S&T is called the "Shale Gas Revolution", and as a result of it, since 2005, the USA's natural gas production has increased drastically, and the world's resource/energy supply and demand condition has been changing.

While in the past, huge shale gas reserves have been confirmed in the USA as hard shale[1] was trapped in layers and the layers were relatively deep, it was difficult to mine, and was therefore neglected. However, hydraulic fracturing technology for mining hard shale in deep layers has been developed and put to practical use, and with the consequent introduction of efficient mining techniques, recently, production in a form that is profitable has become possible.

With regard to the USA's gas supply and demand, the outlook in 2004 that was before the shale gas revolution indicates that in 2025, 28% of domestic consumption would be covered by imports of liquefied natural gas (LNG) and pipeline gas. However, after the shale gas revolution, the USA's natural gas production increased and in 2009, it became the world's biggest natural gas producing country, surpassing Russia. Furthermore, the USA's identifiable recoverable reserves of natural gas are increasing year by year, and the supply and demand outlook in 2010 predicts that in 2035, natural gas imports will have vastly decreased to approximately 6% of domestic consumption.

When the above-mentioned hydraulic fracturing technology is used to mine shale gas, large amounts of active ingredients/substance/components are injected into the ground, and while there are still many problems on the environmental front, such as concerns about water sources and surrounding waterways becoming polluted, the development and spread of this technology can be regarded as a good example of how S&T is contributing to the challenge of stable supply/assurance of the world's resources/energy by developing new resources. In addition, shale gas does not emit as much CO_2 as coal or oil when it is burnt, and is also valuable from the viewpoint of the realization of a low-carbon society. The identifiable recoverable reserves are not eccentrically-located in the Middle East like oil, but are distributed in various areas such as North America, Europe, China, and Australia, and the move to develop the gas/ their behaviour will attract attention in future as we work toward solving our resource/energy problems.

1 A type of mudstone