1.1 The Deepening Relationship Between Science and Technology and Society

This section proceeds with an analysis of the deepening relationship today between science and technology and society, and offers an overview of the policy responses around the world to this relationship.

1.1.1 Changes in Society Due to Scientific and Technological Progress

Scientific and technological progress has had various effects on society. These effects have not been limited to the improvement of society's material wealth, but have also extended to altering the paradigms under which society operates. Information and telecommunications technology (IT) is one example of a paradigm-changing technology. Furthermore, as progress in science and technology has broadened and enlivened human activity, new issues have appeared in society, and these have in turn led to demands for new sciences and technologies capable of resolving the new issues arising from the changes in society.

Section 1.1.1 offers an overview of the current state of the relationship between scientific and technological progress, and society.

1.1.1.1 Achievement of Societal Prosperity

Science and technology have formed the foundations for progress in society, and have helped to make people's lives more materially prosperous. In particular, since the rise of the Industrial Revolution in the latter part of the 18th century, science and technology have shown accelerated progress in energy, physical materials, information and communications, medicine, and many other sectors, resulting in vast improvements in people's health, economic prosperity, and living conveniences (Figure 1-1-2).

Progress in energy and materials technologies has given rise to a variety of new transport modes, such as the railroad, the automobile, and the airplane, vastly improving human mobility in terms of both time and space. These advances in mobility, joined with inventions in the area of telecommunications technology, such as the telephone and radio, have served to broaden the range of human activities and to expand the scope of human exchanges.

In addition, inventions in machine tools have been linked to advances in energy technology to achieve automation and acceleration of manufacturing processes. The result has been large-volume production of goods in ever-shorter periods of time. Moreover, progress in materials technology has resulted in the ability to produce diverse types of material items.

Meanwhile, progress in medical technology has greatly extended people's average life spans and reduced infant and child mortality rates, resulting in a dramatic rise in the world's population (Figure 1-1-3).

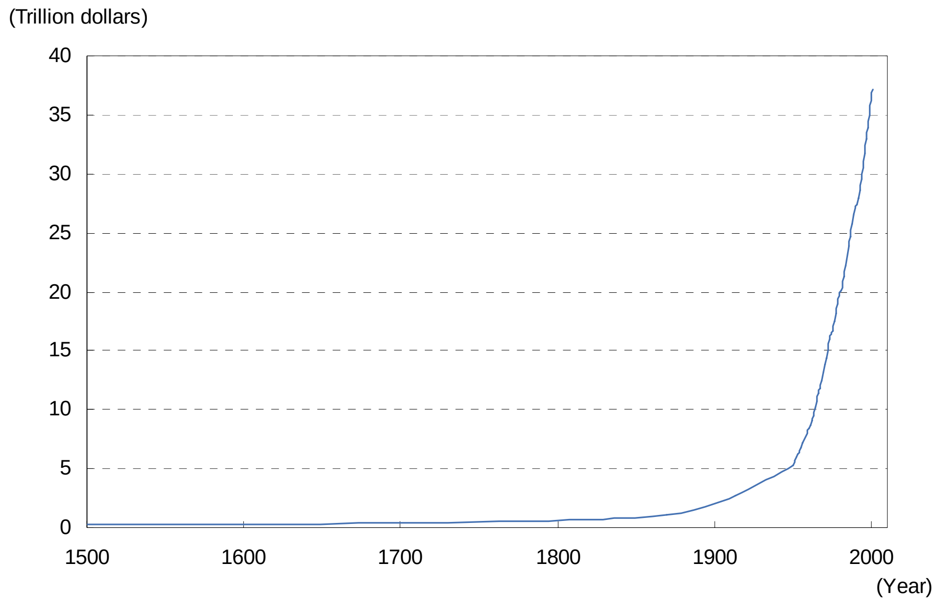


Figure 1-1-2 Long-term trend in world GDP

Source: Survey by the Organization for Economic Co-operation and Development (OECD)

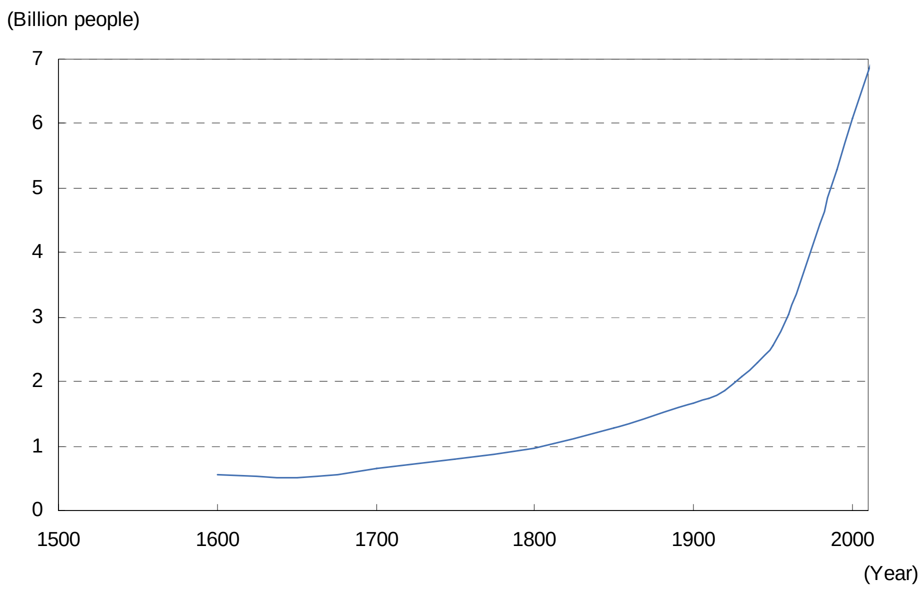


Figure 1-1-3 Long-term trend in world population

Source: Survey by the U.S. Census Bureau

1.1.1.2 Qualitative Changes in Society on a Worldwide Scale

Scientific and technological progress does not merely make people’s lives more convenient and prosperous, it has also brought huge changes to how society itself operates.

Two clear examples in recent years of society undergoing a major change are globalization and the IT revolution.

(Changes in Society Due to Advancing Globalization)

The free movement of people, goods, capital, and information across national borders in vast quantities has accelerated sharply since the late 1980s. This rapidly advancing globalization is already changing the nature of society (Figures 1-1-4 and 1-1-5).

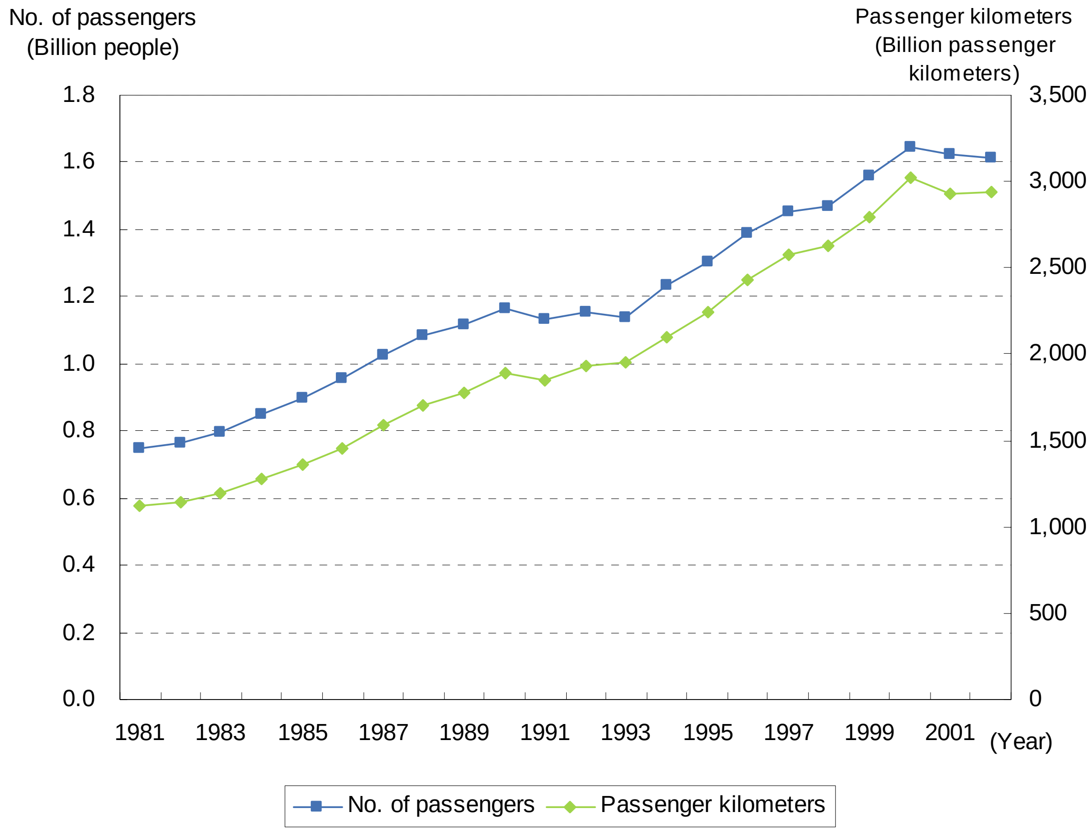


Figure 1-1-4 Trend in world air transport volume (total of international and domestic routes, regular service routes)

Source: Japan Aeronautic Association. “Aeronautic Statistics Outline”

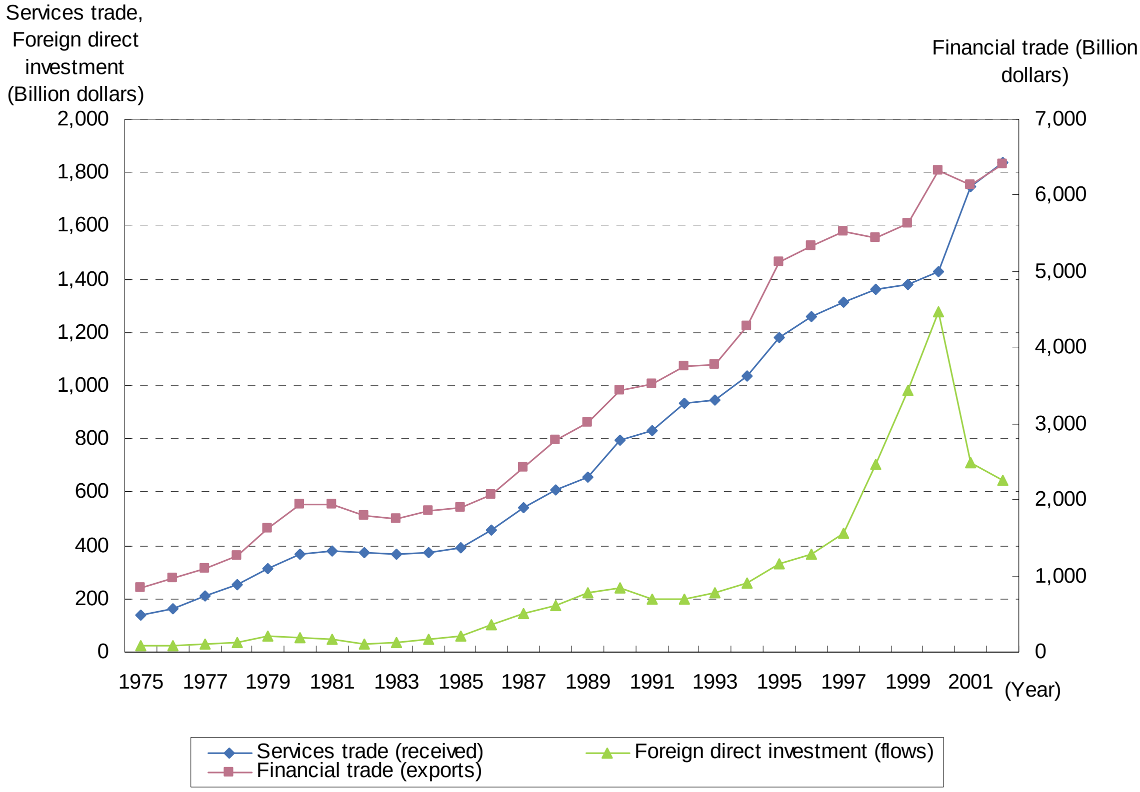


Figure 1-1-5 Trends in world financial trade, services trade, and foreign direct investment

Source: Survey by Ministry of Economy, Trade and Industry

This sudden acceleration of globalization can be traced to the end of the Cold War in 1989, when the political restraints against the international movement of people and goods were relaxed, and when the nations of the former Soviet Union and Eastern Europe abandoned communist-led economies, resulting in expansion of the world's capitalist markets, as well as to the establishment of the World Trade Organization (WTO) in 1995, which served to strengthen the world's free trade and investment systems. These developments form the backdrop for advances in energy and materials technologies, which have led to the appearance of larger scale, faster transport systems, to dramatic progress in information technologies, and to other advances in science and technology.

This rapidly advancing globalization has greatly expanded the realm of individual activities, with international exchanges on a global scale becoming ever more common at all levels of society, from individuals to corporations and regions. The result has been an expansion of trade and investment, and economic development on a worldwide scale, but even more than that, there has been a steady change in the nature of international society itself. In other words, the nation-state once constituted the only entity in international society, and was the medium through which different societies interacted. While the nation-state remains the most important entity, in recent years different levels of societies are increasingly interacting directly with each other without going through nation-state mediation at all.

Globalization has thus served to boost people's prosperity, and to broaden their range of activities, to the point that the very nature of international society is changing. This trend has also given rise to issues that society has never faced before.

For example, the advance of globalization has led to the need for new policies that span international borders, including rules for governing electronic commercial transactions, and better responses to international organized crime. At the same time, the development of international mutually dependent relationships has strengthened ties crossing international borders, so that even such issues as employment, which have previously been considered as purely domestic, must now be treated as issues for the global economy.

Moreover, as seen by the appearance in recent years of such deadly diseases as highly pathogenic avian influenza (Bird Flu), Bovine Spongiform Encephalopathy (BSE), and Severe Acute Respiratory Syndrome (SARS), problems arising in a single region can now spread rapidly to everywhere around the world, and a global watch must be constantly maintained to ensure the safety and security of society.

Furthermore, intensifying competition on a worldwide scale due to rapid globalization has resulted in a new class of competitive losers and others left behind by competition, in both developing countries and in the advanced nations, which has raised fears of social instability, and has stimulated critical reactions from those who believe that market principles ignore people's humanity, culture, and traditions. Many people are beginning to rebel against what they view as a market-coerced "global standard."

(Changes in Society Due to the IT revolution)

A major driving force in the IT revolution has been the Internet. The roots of the Internet can be traced back to 1969, when the U.S. Department of Defense set up the ARPAnet for military purposes, and use for private or commercial purposes was prohibited. In 1990, however, the United States lifted all restrictions to the Internet, and its commercial utilization soon began spreading all around the world, which, combined with advances in computer technology, led quickly to a global information revolution. These advances in information technology dramatically reduced the costs and time required for information distribution, and made possible the manipulation of vast quantities of information. There were about 605.6 million people using the Internet around the world as of September 2002 (Figures 1-1-6 and 1-1-7).

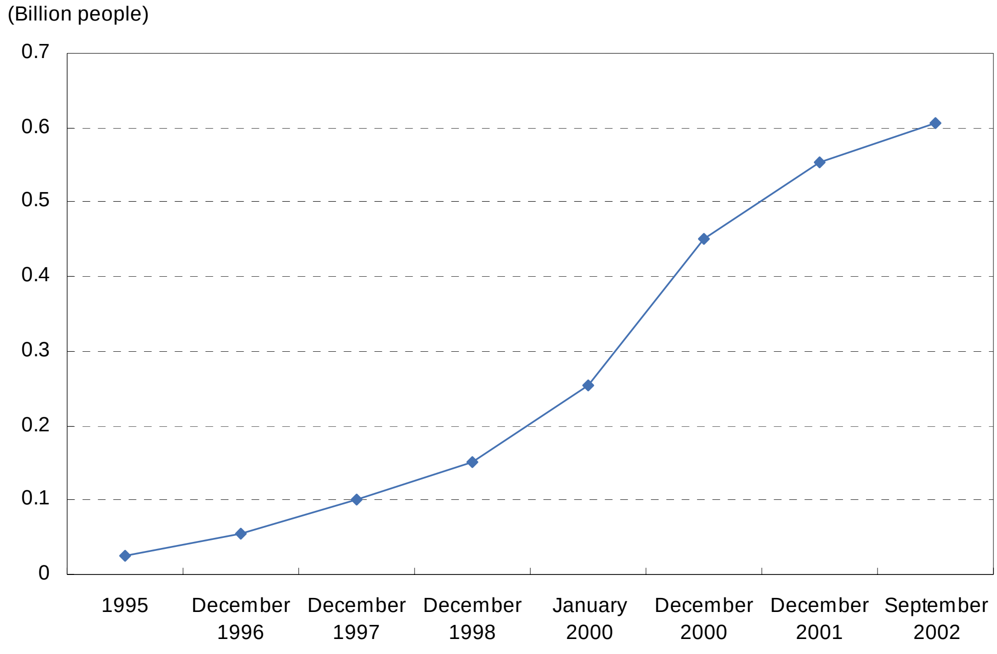


Figure 1-1-6 Trend in the total number of world Internet users

Source: Ministry of Internal Affairs and Communications. "2003 WHITE PAPER Information and Communications in Japan"

(People)

Region	No. of users
Europe	190,910,000
Asia-Pacific	187,240,000
North America	182,670,000
South America	33,350,000
Africa	6,310,000
Middle East	5,120,000
Total	605,600,000

Figure 1-1-7 Number of world users of the Internet, by region (as of September 2002)

Source: Ministry of Internal Affairs and Communications. "2003 WHITE PAPER Information and Communications in Japan"

The effects on society of these advances in IT have not been limited to an improvement in living conveniences, or to increased economic growth through the creation of new industries or improvements in productivity. The ability of computers to connect to the Internet anytime and anywhere is making it possible for the world's people to engage in instantaneous information exchanges with each other, which is leading to an upheaval in the traditional relationships between individuals, between the individual and the corporation, and between the individual and society.

For example, use of the Internet and cyberspace (virtual space) allows individuals to directly collect information about the world without needing to go through media such as newspapers or television, and at the same time to disseminate their own information out to the world as well. People can now go shopping or to work without leaving their own homes, and the result has been diversification of individual lifestyles, and the appearance of new creative activities, so that people in Japan, for example, can interact with other people all over the world to expand the range of their cultural and artistic activities, and cooperate with them in the creation of new artistic works.

On the other hand, the IT revolution has led to all-new societal problems, including the appearance of a Digital Divide (information gap) between generations and between regions, and the issue of information security.

In addition, the IT revolution has led to changes in society on a global scale, and the importance of appropriate responses to these changes, and of the need for international cooperation and contacts, is widely recognized.

In the Kyushu-Okinawa G8 Summit of 2000, Japan took the lead in bringing up information technology as an important issue for discussion, with the result that the "Okinawa Charter on Global Information Society" (IT Charter) was adopted to show the political outlook regarding the future shape of the IT revolution.

The IT Charter states, IT is "one of the most powerful forces for shaping the 21st century," and "its revolutionary effects extend to how people live, how they learn, how they work, and how the government interacts with civil society." In addition, utilization of IT should lead to realization of "a society in which people can demonstrate their own potential, and can boost the possibility of achieving their own hopes." Achievement of this kind of society will, according to the Charter, "allow everybody wherever they may be to participate profitably in the global information society" and "no person should be excluded from this profit."

Furthermore, based on these principles, the IT Charter calls for efforts for the early construction of reliable information networks, the fostering of human resources capable of handling the demands of the Information Age, guarantees of a secure cyberspace, and elimination of the Digital Divide, and shows the direction that should be taken. It also emphasizes the importance of cooperation among nations, international organizations, and private groups to eliminate international disparities.

Moreover, at such international organizations as the Organization for Economic Co-operation and Development (OECD), the World Trade Organization (WTO), and the World Intellectual

Property Organization (WIPO), efforts are ongoing to prepare international responses to such issues as information security, electronic commercial transactions, taxes, privacy, cryptography, and cyber crime prevention.

1.1.1.3 New Societal Issues Arising from Scientific and Technological Progress

While scientific and technological progress has broadened the range of people's activities, and made their lives more prosperous, new societal issues arising from the progress of science and technology have also become apparent.

The most representative example of these issues is undoubtedly the global environmental issue.

The content of global environmental issues can vary widely, from global warming to acid rain, destruction of the ozone layer, destruction of tropical rainforests, and desertification, and a common characteristic of these issues is that they can be traced to increased human activity due to progress in science and technology.

Scientific and technological progress helped mankind to build industrial societies in the 20th century that made wide use of underground resources, and to create prosperous societies and lifestyles. The result, however, was a society based on large-volume production, large-volume consumption, and large-volume waste. But the Earth's resources are obviously not limitless, and there is a limit to the ability of the natural environment to assimilate large volumes of waste. The idea of a "Spaceship Earth," which most vividly demonstrates the Earth's limited nature, was first broached in 1965 by Andrew Stevenson, then U.S. ambassador to the United Nations, who said in a speech that "We travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil." Later, in 1972, the Club of Rome further developed the "Spaceship Earth" concept in stating that there are "limits to growth." In that same year, the United Nations Conference on the Human Environment in Stockholm convened under the theme of "Only One Earth," as the world's people have increasingly come to recognize the limited nature of the planet that they live on.

Since then, discussions about the global environment have proceeded at various levels. At the same time, development has also progressed rapidly, contributing to a deepening crisis for the global environment, a situation made abundantly clear by ever more sophisticated methods of monitoring the globe.

As this situation progressed, it became clear that policies on a global scale were becoming necessary, and the result was the adoption of Agenda 21, an action plan for international efforts to deal with global environment problems, at the United Nations Conference on Environment and Development (UNCED, or the Earth Summit) held in Rio de Janeiro in 1992. Ten years later, in 2002, the World Summit on Sustainable Development (WSSD, or the Johannesburg Summit) was held in Johannesburg to review Agenda 21 and discuss new issues, and the "Johannesburg Declaration on Sustainable Development" was adopted. Sustainable development is a concept that was first incorporated into a report issued in 1987 by the World Commission on Environment and Development entitled "Our Common Future," and asserts that protection of the global environment and development need not be mutually exclusive, but should both be attainable, in the form of development that takes protection of the global environment into account. Sustainable development is now the basic philosophy behind all efforts to deal with global environmental issues today.

As global environmental issues have evolved, the people's awareness has also evolved. According to a survey conducted by the Institute of Statistical Mathematics, people who believed that "to achieve happiness, mankind must be in tune with nature" first exceeded those who believed that "to achieve happiness, mankind must subdue nature" around the year 1970, when the debate about global environmental issues first began to heat up (Figure 1-1-8).

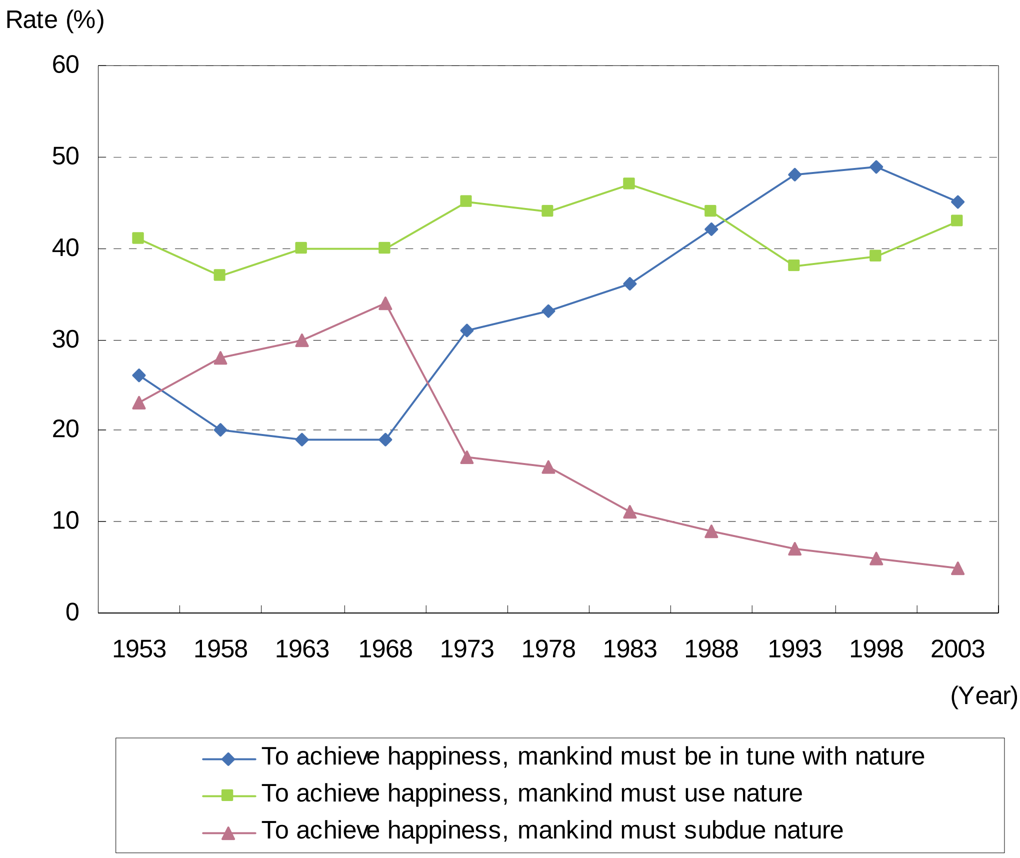


Figure 1-1-8 Relationship between nature and mankind

Source: The Institute of Statistical Mathematics. “Citizenship Research, 11th Nationwide Survey”

Another new societal issue arising from progress in science and technology is in regards to biotechnology. In particular, recent progress in genome analysis is being utilized in the medical and agricultural fields, and the results are expected to contribute greatly to improved human health and the assurance of stable food supplies. These same advances, however, have also raised ethical issues and concerns about safety.

In the area of IT, issues have been raised about a Digital Divide arising between generations and between regions, and also about information security.

As can be seen from the foregoing, various new issues have arisen alongside the progress of science and technology. Moreover, these issues have been made more complex as various ideas were raised in response to the content of specific issues, or to the social standing of different individuals, and have been applied in response to individual issues.

Furthermore, another point that needs mentioning is the fact that science and technology can be the key to responding to these issues. For example, the very existence of global environmental issues first became clear through the development of monitoring technologies, and science and technology is expected to play an important role in resolving such global environmental issues as reduction in the emission of greenhouse effect gases, sulfur dioxides, and nitrogen oxides. And in the area of gene recombination technology, further scientific knowledge is needed regarding its effects.

So far, the majority of people believe that the positive aspects of scientific and technological progress outweigh the negative aspects. Care will be needed, however, to ensure appropriate responses to societal issues that arise alongside the progress of science and technology, so that this attitude is not reversed in the future (Figure 1-1-9).

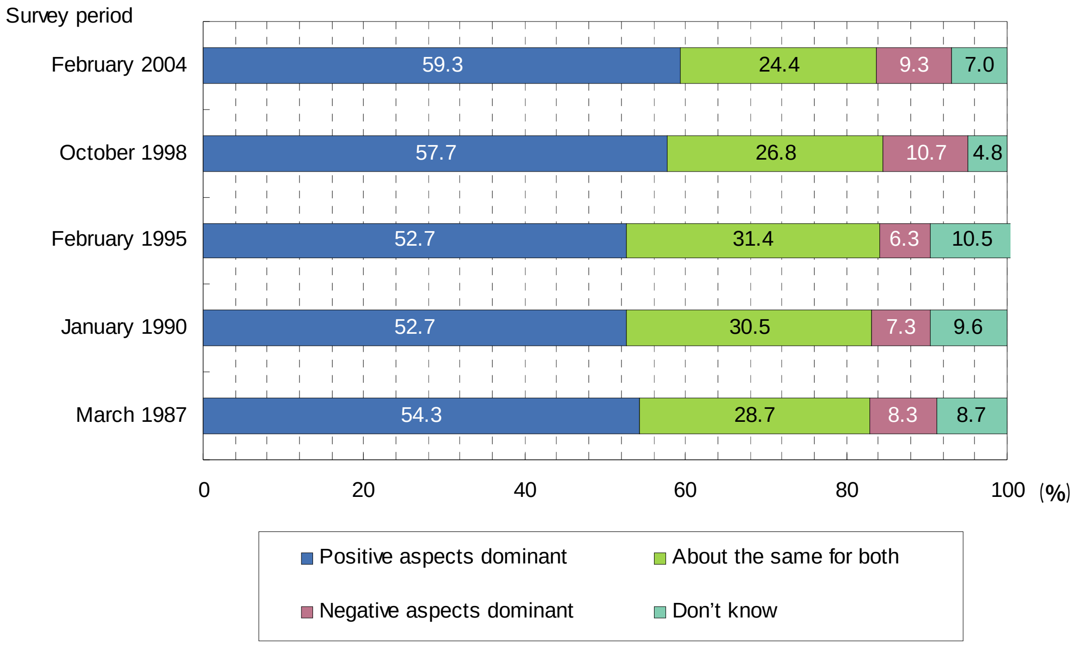


Figure 1-1-9 Positive and negative aspects of scientific and technological progress

Notes: 1. Responses to the question, "Scientific and technological progress is said to have positive aspects and negativeaspects. In general, which do you think is dominant?"
2. In the October 1998 and February 2004 surveys,"Positive aspects dominant" includes "Positive aspects somewhat dominant," and "Negative aspects dominant" includes "Negative aspects somewhat dominant."
Source: Cabinet Office. "Public Opinion Poll on Science and Technology, and Society"

1.1.1.4 Increase of New Factors Threatening Societal Safety and Security

So far, this section has mainly focused on the effect of scientific and technological progress on society. However, if a suitable relationship is to be built between science and technology and society, it is important that science and technology respond appropriately to what society demands.

In the past, societal demands on science and technology centered mainly on people's prosperity, on such things as increasing economic prosperity, health, and other aspects of people's lives.

While demands for a prosperous life remain strong even today, of course, people have responded to changing conditions in recent years at home and abroad with increased expectations for science and technology to ensure the societal safety and security that is a precondition for prosperous societies and lifestyles.

In the domestic arena, for example, the fragility of Japan's large cities has been starkly demonstrated in recent years by incidents that threatened societal safety and security, beginning with the Great Hanshin-Awaji Earthquake of 1995 and other natural disasters, the subway sarin gas attack that same year, the outbreak of toxic E. coli bacteria (O157) in 1996, and other deteriorations in public security.

In the international arena, while the end of the Cold War in 1989 initially led people to believe that the world was headed toward a new area of stability, the multiple terror attacks on the United States on September 11, 2001, the railway bombing terror attack in Spain on March 11, 2004, and many other terrorist incidents have left the world feeling very insecure. There are also threats from emerging or reemerging infectious diseases. Furthermore, the advance of globalization means that risks arising in certain countries or regions can quickly spread to locations anywhere in the world, as can be seen by the global spread in recent years of such diseases as avian influenza, BSE, and SARS.

In response to these myriad risks, people have in recent years become much more concerned about safety and security.

For example, in the "Public Opinion Poll on Social Awareness (January 2004)," a large proportion of respondents thought that security is one area where the situation is getting worse, and the ratio was higher than in the previous survey, conducted in December 2002 (Figure 1-1-10).

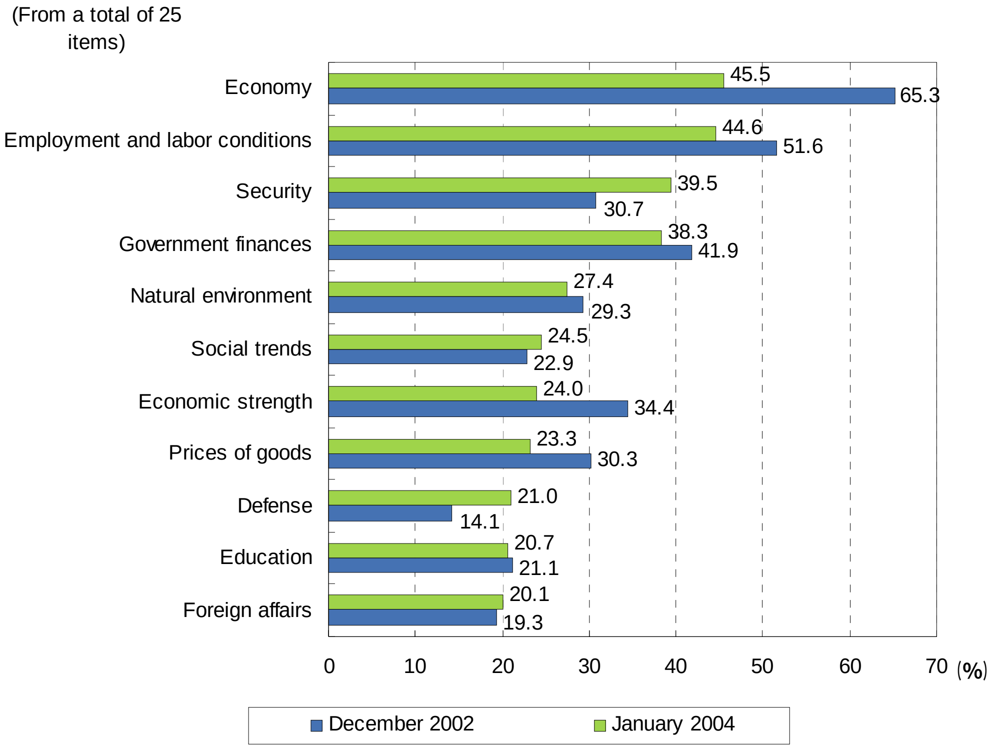


Figure 1-1-10 Areas in which Japan's present condition is getting worse

Source: Cabinet Office. "Public Opinion Poll on Social Awareness (January 2004)"

In addition, in the “Citizen’s Life Preference Survey (FY2002),” in which respondents were asked to rank 60 items related to their lives in order of importance, the top 10 survey result items all related to safety and security (Figure 1-1-11).

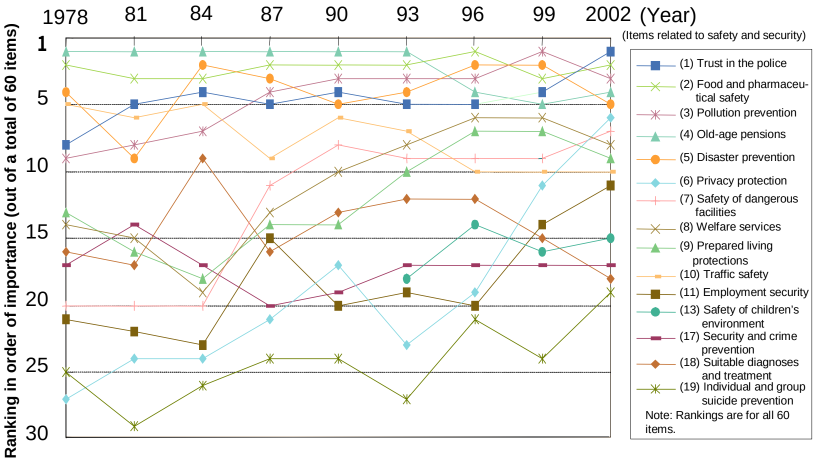


Figure 1-1-11 Trend in order of importance placed on items related to safety and security

Note: Of the 60 items surveyed in the Citizen’s Life Preference Survey , this figure shows the trend over the years in the rankings for items related to safety and security.
Source: Prepared by MEXT based on the Cabinet Office’s “Citizen’s Life Preference Survey (FY2002)”

Meanwhile, a question in the “Public Opinion Poll on Science and Technology and Society (February 2004)” regarding what topic people would most like to hear about from scientists or technologists found that a relatively high proportion of respondents selected “science and technology related to safety and security” (Figure 1-1-12).

These survey results appear to show that society demands further progress in science and technology related to safety and security.

In addition, a varied response from societal systems is needed to ensure society’s safety and security, and it is important that efforts in line with such responses be promoted.

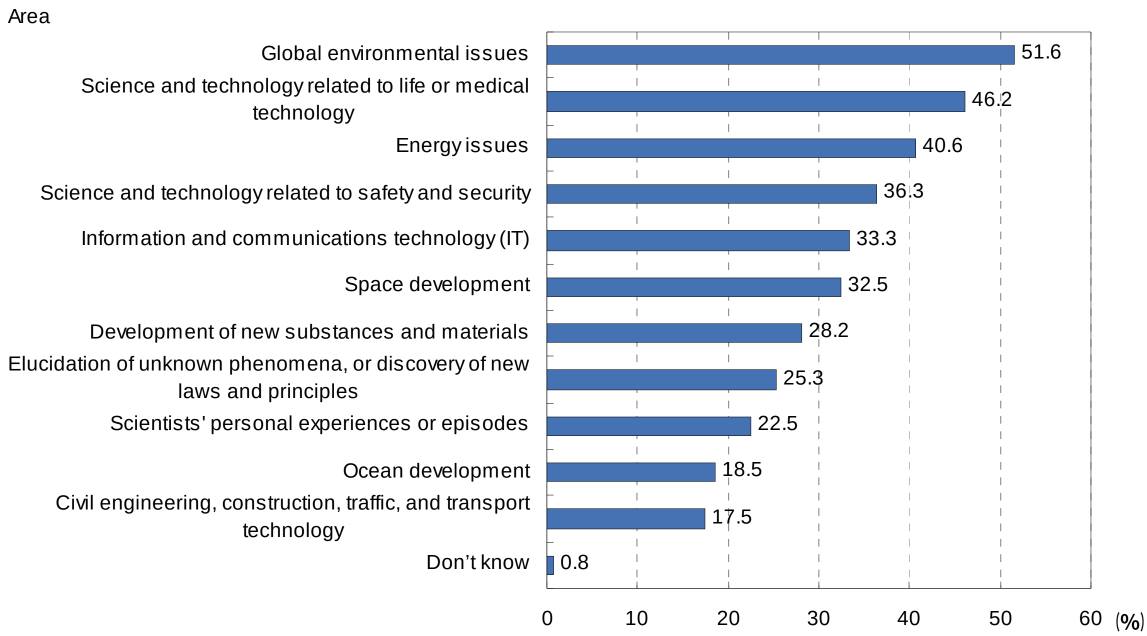


Figure 1-1-12 What sort of topics would you like to hear about from scientists?

Note: Response to the question, “What sort of topic on science and technology would you like to hear about from scientists or technologists?”
Source: Cabinet Office. “Public Opinion Poll on Science and Technology, and Society (February 2004)”

1.1.1.5 Relationship between Science and Technology and Society

(Science and Technology and the State)

At the time of the Industrial Revolution, the role of putting the results of science and technology to practical use in society was assumed mainly by entrepreneurs. These entrepreneurs used scientific and technological results for the development of products and improvement of production systems, in order to turn a profit. Where new scientific and technological results led to the creation of new industries, the needs of entrepreneurs also led to the creation of new sciences and technologies. Basically, the interaction between scientists, technologists, and entrepreneurs resulted in scientific and technological progress, and the people of society received the benefits of scientific and technological results.

As the years passed, moving from the 19^{th} century into the 20^{th} century, the situation gradually changed. Entrepreneurial utilization of science and technology, and the resultant dissemination of scientific and technological results to society, grew in size as the scale of economic activities expanded.

Meanwhile, as competition between nation-states became more intense, the state also came to focus on the importance of science and technology as a source of national power from the point of view of national security. As can be seen from the power in the military sphere that science and technology demonstrated in the two world wars, nations everywhere were increasingly recognizing the importance of science and technology to the point that, after World War II, science and technology policy came to be positioned as an integral part of national policy. In this way, the nation-state joined entrepreneurs in the role of promoting science and technology, and putting its results to practical use in society.

Of course, the nation-state was not interested in the products of science and technology merely for the enhancement of national prestige or for military uses, they were also used for the promotion of industry, soil preservation and flood control measures, the development of road and rail networks, the development of sewer and water lines, assurance of energy sources, and many other societal infrastructure improvements. Moreover, much of what was developed for the enhancement of national prestige or for military purposes also turned out to have practical uses in society.

With the end of the Cold War in 1989 and the collapse of the bipolar world structure centered around the United States and the Soviet Union, the situation changed again. First of all, the great power arms race centering on weapons of mass destruction faded away, and the significance of national prestige based on science and technology relatively lessened. At the same time, the collapse of Communism and the rise of globalization promoted unification of the world’s markets, and global economic activities surged ahead. In line with these developments, one of the main objectives for national science and technology policy came to be economic development, with the result that more emphasis was placed on policy than ever. Moreover, utilization of scientific and technological results became increasingly important in social welfare, social infrastructure development, and all other arenas of state activity.

In recent years, furthermore, the occurrence of large-scale natural disasters, the global spread of infectious diseases, and frequent terrorist attacks beginning with the multiple terrorist attacks on the United States in 2001, have focused attention on the ability of science and technology to ensure the safety and security of states and societies in ways that go beyond military power.

(Science and Technology and the Individual)

Until recent years, the relationship between science and technology and the individual, has basically been one of the individual passively receiving the results of science and technology. While the benefits of science and technology have varied to some degree depending on the country or region, they have basically been recognized as being shared all across society, and the reception of people to scientific and technological progress has generally been positive and shared.

In addition, individuals had a relatively wide range of choices in regards to whether or not to utilize the results of science and technology. While the utilization of home electrical appliances such as refrigerators or washing machines, for example, offers everyone the same kind of benefit in terms of reduction of labor, if an individual were for some personal reason to decide not to make use of these devices, the only result would be a missed opportunity to reduce his or her own labor, a situation that would cause little inconvenience to

science and technology, are inducing great changes in the very nature of society, so that individuals no longer have any choice but to be swept along by the effects of scientific and technological advances. For example, further advances in the IT revolution will serve to make communications via the computer or Internet more general than ever, and failure to make use of that technology will not only be simply a matter of inconvenience, but also will represent a drastic narrowing of possibilities for individual activities in the areas of business, research, learning, medicine and welfare, arts and culture, entertainment, and many other aspects of daily living, to the point that even information deemed absolutely essential for life may become unobtainable. In addition, when such activities as electronic trading, Small Office, Home Office (SOHO), and remote medical treatment based on IT become the norm, an inability to use computers or the Internet could severely restrict the range of services that an individual can receive or his or her range of employment choices. Furthermore, the IT revolution will surely boost the value of information in society and life, and with the acquisition and dissemination of information via the Internet becoming the norm, a lack of access to the Internet will severely limit the range of information that an individual can obtain, placing that individual in an extremely inconvenient situation.

With progress in science and technology changing the very nature of society, failure to utilize the results of science and technology could leave an individual incapable of dealing with the new society, and saddled with a narrow range of choices regarding utilization of scientific and technological results.

Moreover, the global environmental problems that have arisen in the wake of the expansion of human activities due to scientific and technological the society at large.

In recent years, however, advancing globalization, as well as the IT revolution and other advances in progress adversely affect individuals regardless of their own choices. And as the case of gene-recombinant crops shows, those who benefit from the utilization of scientific and technological results are beginning to steer a different course from those who must bear the risks.

Meanwhile, society's demands on science and technology are rising, as can be seen by the expectations society places on science and technology in regards to the safety and security issue.

The relationship between science and technology and individuals, therefore, is becoming close and inseparable, and is also becoming more diverse, according to the needs of each individual. As a result, the time is approaching when individuals will need to make decisions on how to relate to science and technology. Toward this objective, individuals will need to have an interest in science and technology, and to possess enough knowledge to be able to make an informed decision.

But even though society is already changing in this direction, the "Public Opinion Poll on Science and Technology and Society (February 2004)" found that, in Japan, the people's interest in science and technology was declining.

Slightly more than 50% of respondents, for example, expressed an interest in news and issues that involve science and technology. While a majority, the percentage was lower than the response ratios seen in the survey results for 1990, 1995, and 1998. By age group, interest among people in the age 29 and under group declined particularly sharply year by year (Figures 1-1-13, 1-1-14).

Furthermore, the ratio of respondents who did not feel any interest or enjoyment from contact with science and technology rose from 29.1% in February 1995 to 44.2% in the latest survey (Figure 1-1-15).

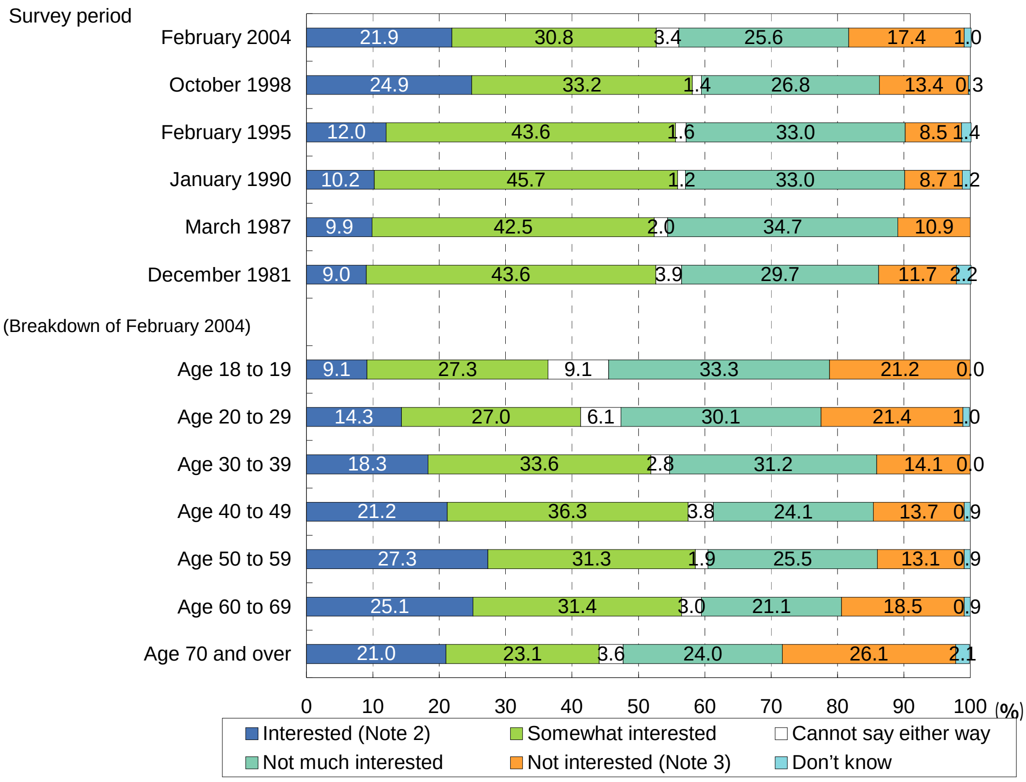


Figure 1-1-13 Interest in news or topics about science and technology

Notes: 1. Response to the question, “Are you interested in news or topics about science and technology?"
2. In the surveys up to February 1995, this response was “Extremely interested.”
3. In the December 1981 survey, this response was “Not interested (at all),” and in the surveys from March 1987 to February 1995, it was “Not interested at all.”
4. In the March 1987 survey, “Cannot say either way” also includes “Don't know.”

Source: Cabinet Office. “Public Opinion Poll on Science and Technology and Society (February 2004).”

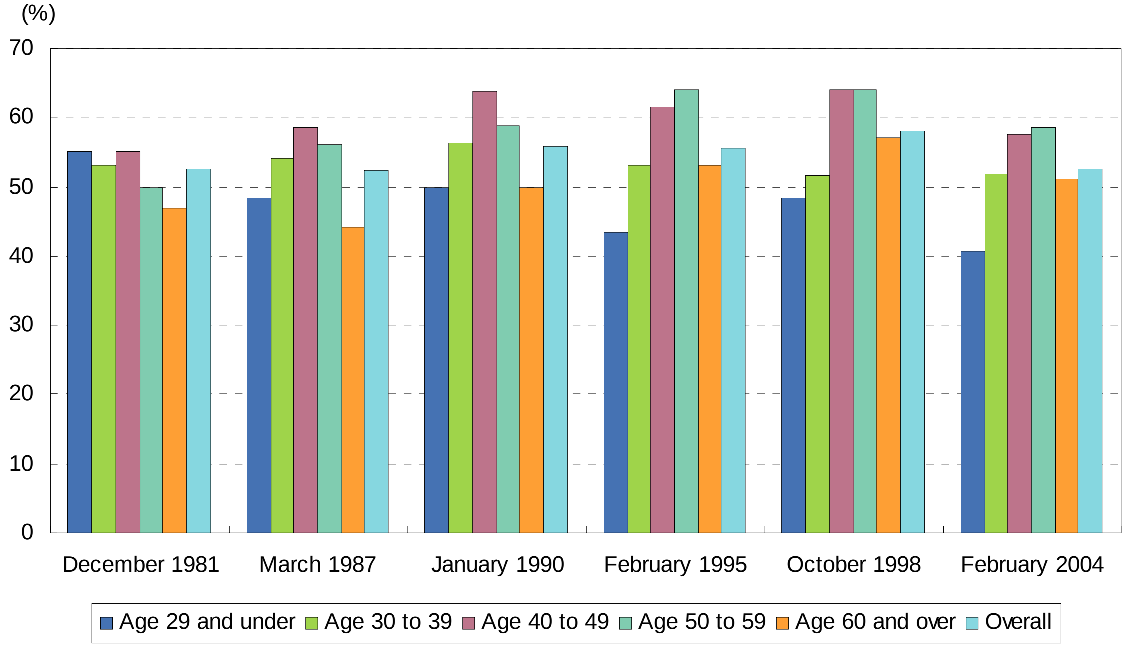


Figure 1-1-14 Trend in degree of interest in science and technology, by age group

Source: Cabinet Office. “Public Opinion Poll on Science and Technology and Society”

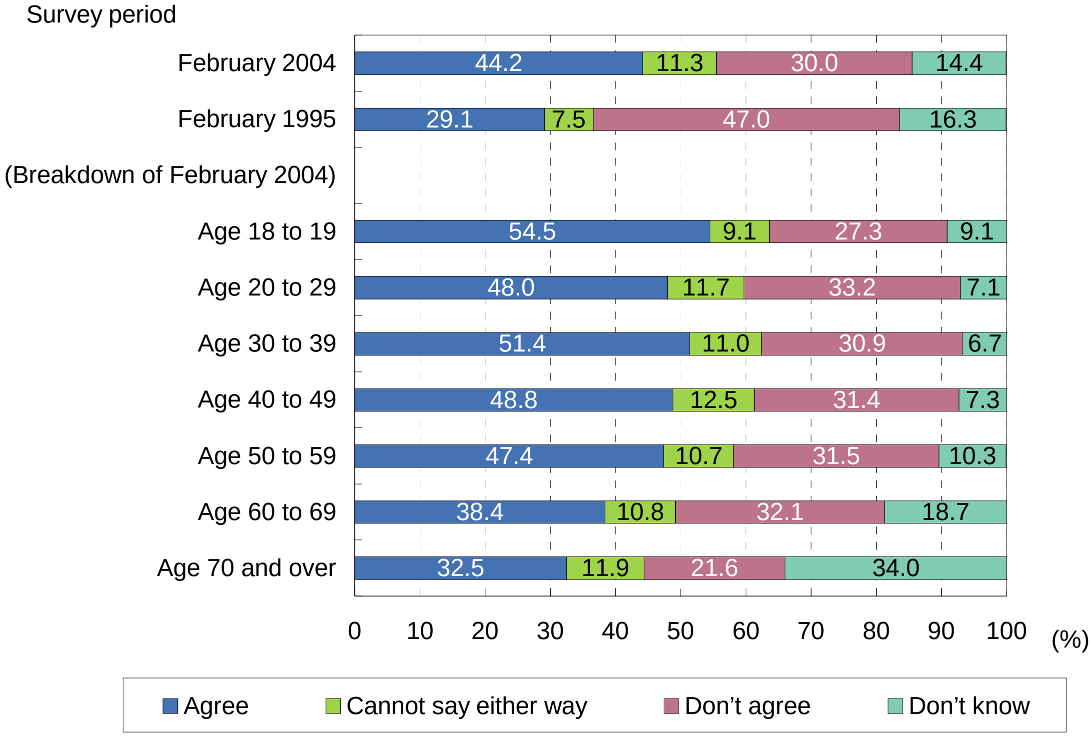


Figure 1-1-15 Cannot feel any interest or enjoyment from contact with science and technology

Notes: 1. Response to the question, “What do you think about the opinion that ‘I cannot feel any interest or enjoyment from contact with science and technology’?”
2. In the February 1995 survey, “Agree” is a combination of “I completely agree” and “I agree,” while “Don’t agree” is a combination of “I don’t agree at all” and “Don’t agree.” In the February 2004 survey, “Agree” is a combination of “Agree” and “Somewhat agree,” while “Don’t agree” is a combination of “Don’t agree very much” and “Don’t agree.”

Source: Cabinet Office. “Public Opinion Poll on Science and Technology and Society (February 2004)”

As will be seen in the next section, this trend is not limited to Japan, but is also occurring in the United States and in Europe, and appears to be common throughout the advanced nations. Restoring the people’s interest in science and technology has become an urgent issue.

(The Need for Building a New Relationship between Science and Technology and Society)

The following can summarize what has been said so far in this section regarding the current relationship between science and technology and society.

First, science and technology has not only made human society more prosperous, it has been the engine driving the evolution of the very nature of society. Moreover, expectations are high that science and technology will continue playing this role in the future, and will also be responsive to new issues that arise as times change, such as ensuring the safety and security of society.

Next, as seen in such areas as global environmental problems and bioethical issues, examples where scientific and technological progress can have both good and bad effects on society already exist, and as seen with information technology, there exist sciences and technologies that are becoming absolutely essential for society and people’s lives. In a word, the relationship between science and technology and society, and particularly with individuals, is becoming close and inseparable, and the time is approaching when individuals must think clearly about what kind of relationship they should have with science and technology. Despite this situation, however, people's interest in science and technology appears to be on the decline, at least in advanced countries such as Japan.

What is needed in this situation is for science and technology to respond flexibly to the needs of society as they change over time, or in other words, to become a "science and technology for society."

At the same time, scientists, technologists, and other people involved in science and technology should be aware of the role that science and technology plays in society, and of its influence, and should actively strive to convey information about their own activities to society. They should also try to help people at the individual level to obtain a deeper interest in and knowledge of science and technology, so as to able to utilize science and technology themselves. Moreover, cooperation among the community of scientists, corporations, individuals, and every other level of society should be harnessed to promote science and technology and thus help society to develop. In other words, what is needed is "science and technology in society."

The path that science and technology needs to take in the future is thus "science and technology for society, and in society." Only when these viewpoints are understood can science and technology move on to contribute even more to the future development of human society.

1.1.2 World Policy Trends Related to Science and Technology and Society

Section 1.1.1 discussed how scientific and technological progress has further deepened the relationship between science and technology and society. This next section features an introduction of trends around the world in response to the above changes, using as a representative example the global environmental problem of global warming. The section also includes an introduction of trends in regard to “science and technology for society, and in society,” as seen in the World Conference on Science convened in Budapest in 1999, and in science and technology policies drawn up in the United States and European countries.

1.1.2.1 Contribution of Science and Technology to the Global Warming Problem

Global environmental problems are new issues facing society as a result of the expansion of human activities as science and technology has progressed. One such issue, in particular, is the global warming problem, which provides an example of scientists first clarifying the mechanism and tracing its origins, and then, as scientific knowledge accumulated in the course of further progress in science and technology, using the provision of climate change monitoring data and future forecasting data as an opportunity to establish a framework for international society as a whole to engage the problem and move toward a solution.

(Discovery of the Global Warming Phenomenon, and Progress in the Accumulation of Scientific Knowledge)

Global warming refers to the phenomenon of rising worldwide temperatures and a changing climate caused by high and rising concentrations of carbon dioxide and other greenhouse gases in the atmosphere due to increased human activity. A theory elucidating the mechanism for this warming effect was first described by the Swedish physicist Svante Arrhenius near the end of the 19th century.

In 1958, Charles Keeling of the U.S. Scripps Institution commenced periodic monitoring of carbon dioxide concentrations in the atmosphere at the Mauna Loa Observatory in Hawaii. The data collected through this monitoring showed conclusively that carbon dioxide concentrations were rising, and scientists everywhere redoubled efforts to research global warming in their own regions (Figure 1-1-16).

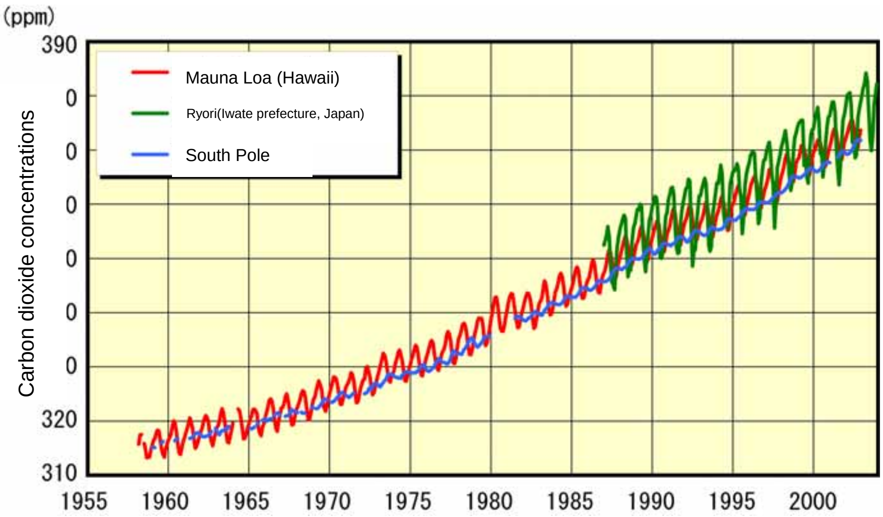


Figure 1-1-16 Trends in carbon dioxide concentrations in the atmosphere

Source: Japan Meteorological Agency. “Climate Change Monitoring Report 2003"

As the monitoring data accumulated, scientists spoke out about global warming and began raising the alarm. In 1985, the United Nations Environment Programme (UNEP) hosted the Villach (Austria) Conference, the world's first international conference of scientists on global warming. At this conference, the scientists issued a statement that "the rise in the average global temperature by the middle of the 21st century could well be on a scale not seen since the dawn of humanity," marking the first time scientists had joined together to issue a warning to society about global warming.

Up to that time, only scientists had sounded the alarm about global warming, and government policymakers had yet to become involved in the global warming discussions.

(Contribution of Scientific Knowledge to Policymaking)

Since the Villach Conference, the global warming problem has come to be widely recognized in society, and scientists and policymakers are at last working together to promote discussion of the global warming problem.

The main role in this effort has been played by the Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the World Meteorological Organization (WMO) and UNEP. The IPCC, which is composed of both scientists and policymakers, is the first such organization to operate at the governmental level, and was established for the purpose of gathering and assessing the latest scientific, technological, and socioeconomic data regarding climate change, and for assisting national governments.

The First Assessment Report published by the IPCC in 1990 stated "average earth temperatures will rise by about 3 degrees by the year 2100. In order to hold concentrations in the atmosphere at current levels, carbon dioxide emissions will need to be cut by more than 60%," and concluded that "continued accumulations of man-made greenhouse gases in the atmosphere will result in climate change that will have unavoidably serious effects on nature and on human systems." In response to this report, the United Nations General Assembly approved a decision in 1991 to launch the Intergovernmental Negotiating Committee to discuss the "Framework Convention on Climate Change," and the convention was adopted in the following year of 1992 at the fifth resumed session of the negotiating committee. Later that year, the Framework Convention on Climate Change was readied at the United Nations Conference on Environment and Development (the so-called "Earth Summit" in Rio de Janeiro) for signing.

Later, the IPCC continued gathering and reviewing scientific knowledge, releasing the Second and Third Assessment Reports in 1995 and 2001, and revising and improving its climate change forecasting models. While some areas of uncertainty remain, the reliability of these forecasting models has improved greatly (Table 1-1-17). This is clearly expressed in the report descriptions. The Second Assessment Report, for example, asserted that "identifiable human effects have appeared in the general global climate," and the report was used as a basis for the adoption of the Kyoto Protocol, which made reduction of greenhouse gases legally binding, is at the Third Conference of the Parties (COP3) held in Kyoto in 1997. Furthermore, the Third Assessment Report released in 2001 clearly stated that "according to more powerful evidence obtained in recent years, virtually all of the global warming monitored in the last 50 years has been due to human activity" (Figure 1-1-18).

Table 1-1-17 IPCC forecast figures for global warming

	1st Assessment Report (April 1990)	2nd Assessment Report (December 1995)	3rd Assessment Report (March 2001)
Carbon dioxide density in atmosphere	About 800ppm	750 - 1000ppm	540 - 970ppm
Average ground temperatures	Rise of about 3℃	Rise of 1.0 - 3.5℃	Rise of 1.4 - 5.8℃
Average ocean surface level	Rise of about 0.65m	Rise of 0.13 - 0.94m	Rise of 0.09 - 0.88m

Source: IPCC. "Assessment Report"

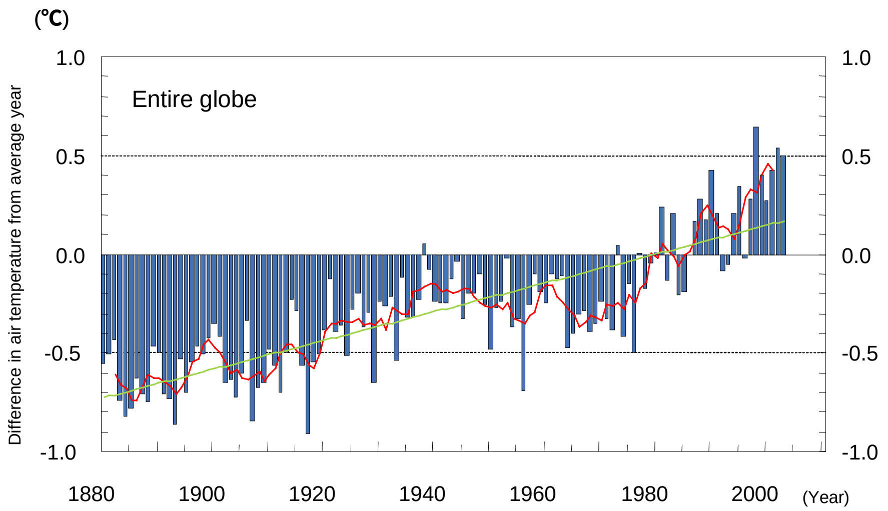


Figure 1-1-18 Changes in global ground temperatures (1880 to 2003)

Note:The bar graphs (blue) show the difference in air temperature for each year from the average year (average value for the 30-year period from 1971 to 2000), while the red line represents the five-year moving average of the difference from the average year, and the straight line (green) shows the long-term trends of the average difference.

Source: Japan Meteorological Agency. "Climate Change Monitoring Report 2003"

Nevertheless, in March 2001, immediately after the release of the Third Assessment Report, the United States, the world's largest source of carbon dioxide emissions, announced it was withdrawing from the Kyoto Protocol. The reasons given for withdrawal included the lack of obligations on the part of developing countries to reduce emissions, which was called unfair, and the possibility of adverse effects on the U.S. economy. The U.S. government also pointed out the scientific uncertainties in the Kyoto Protocol, and in May 2001 asked the U.S. National Academy of Sciences (NAS) for its opinion on the IPCC report. The NAS responded with the release of a report which agreed in general with the content of the IPCC assessment report, but concluded that clarification at a higher standard of reliability was needed.

The Third Assessment Report won the support of participants at a ministerial-level meeting of the Ninth Conference of the Parties to the Framework Convention on Climate Change (COP9), held in Milan in December 2003, because it provides a clear scientific basis for taking policy action against global warming, and will be utilized as the basis for future international negotiations. The results of this conference appeared to show that policies against global warming cannot make progress without the contribution of science and technology, in the form of global monitoring and change forecasting (Figure 1-1-19).

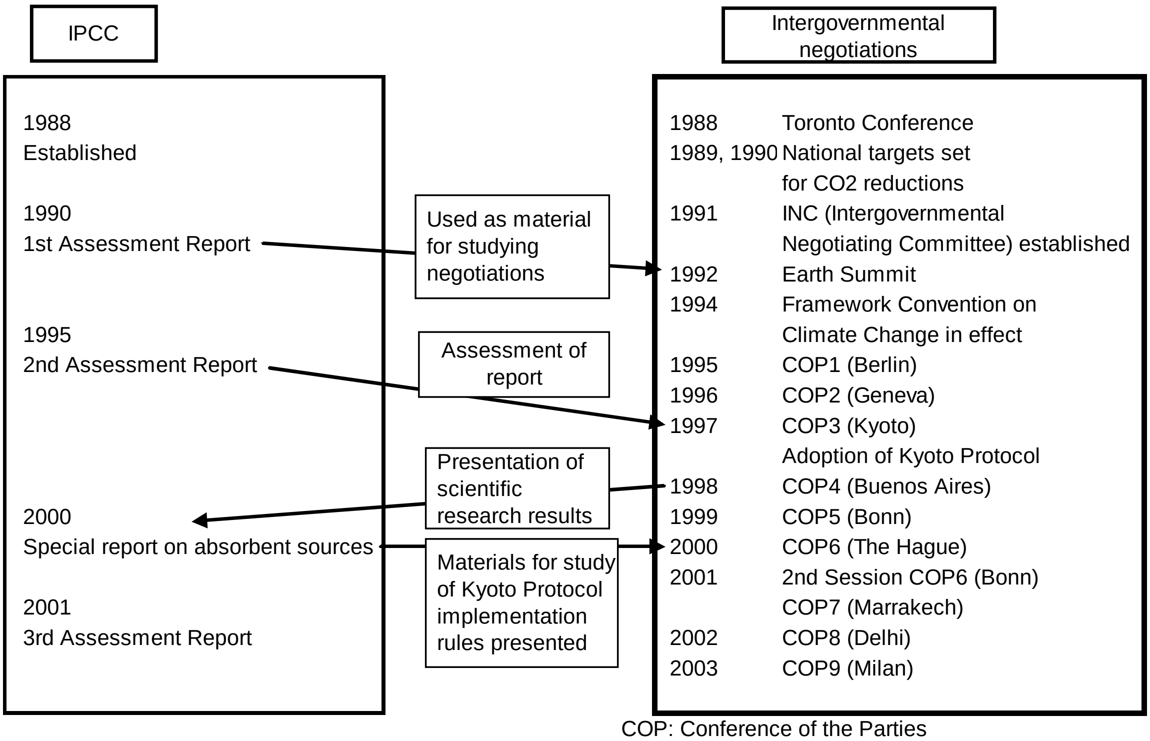


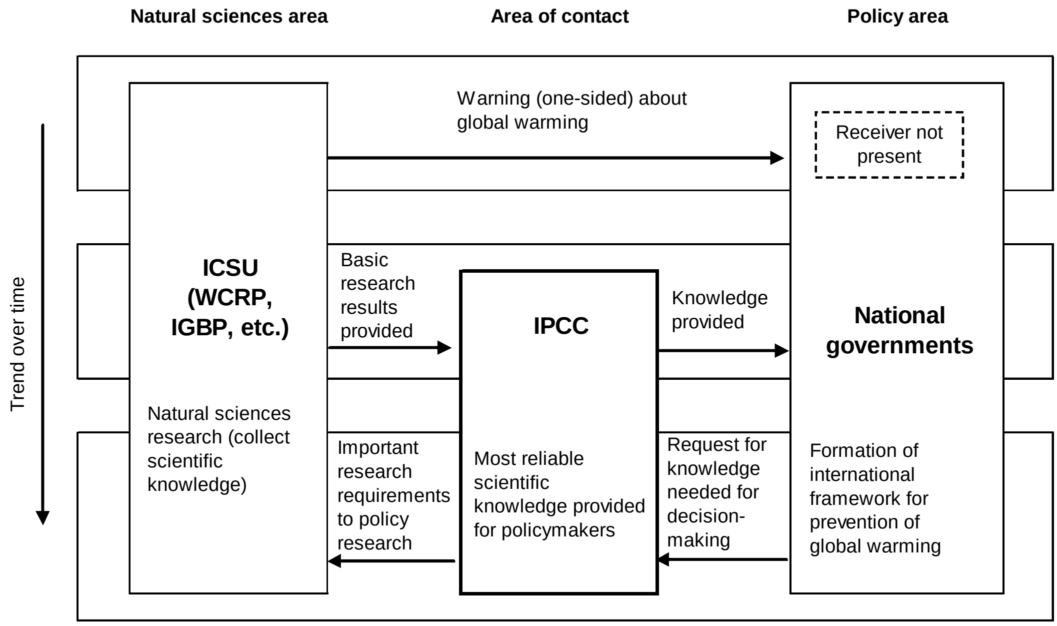
Figure 1-1-19 Relationship between IPCC and inter-governmental negotiations

Source: Prepared by MEXT, based on materials from the Council for Science and Technology Policy (August 2001)

As can be seen, international society is increasingly placing expectations and demands on science and technology toward the resolution of global environmental problems.

At the World Summit on Sustainable Development (Johannesburg Summit), attended by 191 nations around the world in 2002, the participants adopted the Johannesburg Declaration on sustainable development, as well as an Action Plan for the Declaration. The Action Plan incorporates high expectations for science and technology, and states that "improving cooperative structures between scientists in the natural sciences and social sciences, and between scientists and policymakers, will improve policy and decision-making at all levels, including emergency actions at every level," and promises to "continue supporting IPCC and other international scientific assessments in support of decision-making, and to cooperate with them." In addition, to elucidate global climate change and its effects, the Action Plan also "recommends organized monitoring of the Earth's air, land, and sea" and "recommends the development and wide-ranging use of Earth monitoring technology."

Later, adoption of the "G8 Science and Technology Action Plan for Sustainable Development," which includes calls for strengthening international cooperation for Earth monitoring, at the 2003 Summit of Advanced Nations (G8: Evian Summit), shows that science and technology is playing an increasingly important role, and that expectations are rising (Figure 1-1-20).



ICSU: International Council for Science WCRP: World Climate Research Programme
IGBP: International Geosphere-Biosphere Programme

Figure 1-1-20 About the relationship between science and policy

Source: Prepared by MEXT, based on materials from the Council for Science and Technology Policy (August 2001)

The rapid development of Earth monitoring technologies and other sciences and technologies since the start of the 20th century has made it possible to make more precise and more reliable forecasts of future climate change. This accumulation of scientific knowledge has helped persuade national governments to recognize the importance of international efforts for the prevention of global warming, and has resulted in mandates for governments to promote policies toward that end. In other words, science and technology has come to have a major effect on global-scale decision-making in society, or to put it another way, the day has arrived when policymaking cannot proceed without input from science and technology.

1.1.2.2 New Responsibilities for Science and Technology in the 21st Century

The World Conference on Science (Budapest Conference) convened in the Hungarian capital of Budapest in July 1999 under the joint auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Council for Science (ICSU) was an event that marked a global turning point, with scientists re-examining the future of science and technology, and the nature of science.

The background to convening this conference can be described as follows: Where scientific and technological progress over the past several decades brought economic prosperity, it also had a negative side, such as environmental problems, that needed to be newly resolved. In recognition of the fact that the negative problems could not be resolved without the appropriate and timely utilization of science and technology, and that , it was necessary for science society, industry, government, and citizens to meet at a single location, the conference attracted about 1,800 people from around the world, including scientists, technologists, legislators, journalists, bureaucrats, and ordinary citizens, to talk for six days about the nature of science in the 21st century.

The conference adopted the “Declaration on Science and the Use of Scientific Knowledge” and the “Science Agenda – Framework for Action” to state the new responsibilities for the promotion of science in the 21st century.

The preamble to the Declaration states “the sciences should be at the service of humanity as a whole, and at the same time, should contribute to providing everyone with a deeper understanding of nature and society, a better quality of life, and a sustainable and healthy environment for present and future generations.”

Furthermore, the Declaration adds “today, whilst unprecedented advances in the sciences are foreseen, there is a need for a vigorous and informed democratic debate on the production and use of scientific knowledge. The scientific community and decision-makers should seek the strengthening of public trust and support for science through such a debate,” and then lists four concepts as responsibilities for science in the 21st century, including the already functioning “science for knowledge,” as well as the new “science for peace,” “science for development,” and “science in society, and for society” concepts (Table 1-1-21).

The “Science Agenda – Framework for Action” presents specific actions that governments and the community of scientists should take to fulfill the contents of the Declaration.

Table 1-1-21 Overview of the "Declaration on Science and the Use of Scientific Knowledge"

<Preamble>

The sciences should be at the service of humanity as a whole, and should contribute to providing everyone with a deeper understanding of nature and society, a better quality of life, and a sustainable and healthy environment for present and future generations.

Today, whilst unprecedented advances in the sciences are foreseen, there is a need for a vigorous and informed democratic debate on the production and use of scientific knowledge. The scientific community and decision-makers should seek the strengthening of public trust and support for science through such a debate.

The main text consists of the following four sections:

1. Science for knowledge; knowledge for progress
   - Promoting fundamental and problem-oriented research is essential for achieving endogenous development and progress.
   - The public sector and the private sector should work in close collaboration and in a complementary manner in the financing of scientific research for long-term goals.
2. Science for peace
   - Worldwide cooperation among scientists makes a valuable and constructive contribution to global security and to the development of peaceful interactions between different nations, societies and cultures.
   - The natural and social sciences and technology need to be used as tools to address the root causes and impacts of conflict.
3. Science for development
   - Enhanced support should be provided for building up an adequate and evenly distributed scientific and technological capacity through appropriate education and research programmes as an indispensable foundation for economic, social, cultural, and environmentally sound development.
   - Science education, in the broad sense, without discrimination and encompassing all levels and modalities, is a fundamental prerequisite for democracy and for ensuring sustainable development.
   - The building of scientific capacity should be supported by regional and international cooperation, and progress in science requires various types of cooperation.
   - In each country, national strategies and institutional arrangements and financing systems need to be set up, or the role of sciences in sustainable development enhanced.
   - Measures should be taken to enhance those relationships between the protection of intellectual property rights and the dissemination of scientific knowledge that are mutually supportive.
4. Science in society, science for society
   - The practice of scientific research and the use of knowledge from that research should always aim at the welfare of humankind, including the reduction of poverty, and be respectful of the dignity and rights of human beings, and of the global environment.
   - Each country should establish suitable measures to address the ethics of the practice of science and of the use of scientific knowledge and its applications.
   - All scientists should commit themselves to high ethical standards.
   - Equal access to science is not only a social and ethical requirement, but also essential for realizing the full potential of scientific communities worldwide, and for scientific progress that meets the needs of humankind.

Up through the 20^{th} century, science has progressed based on "science for knowledge," so that while it produced various results and benefits for society, it also produced negative environmental problems. The Declaration is undoubtedly the result of recognition by the community of scientists that they are in danger of losing the trust and support of society if science and technology in the 21^{st} century cannot contribute to the resolution of these negative issues.

At the Johannesburg Summit of 2002, then-chairman Hiroyuki Yoshikawa of the ICSU, who had been invited to represent the community of scientists, clearly stated in a speech that "the science and technology community bears a responsibility to engage with the issue of general and comprehensive sustainable development through education, training, research, and the technological revolution. Scientists and technologists should be responsive to demands for knowledge required by society, the private sector, and government in order to devise solutions and choices regarding sustainable development." Earlier, in 2001, about 90 science academies from around the world joined to establish the InterAcademy Council (IAC), for the purpose of offering scientists' advice for policymaking by the United Nations and other international institutions.

Efforts to implement the specifics of the Budapest Conference Declaration are currently in progress.

In Japan, as well, the Second Science and Technology Basic Plan now in effect positions "building a new relationship between science and technology and society" as its basic philosophy, and developing policies for the establishment of communications between science and technology and society, and for returning scientific and technological results back to society. In addition, consideration of the future of the Science Council of Japan, which represents the community of scientists in Japan, was conducted, and a proposal was completed in July 2003. In line with the Budapest Conference Declaration, the new proposal places emphasis on the council's functions for policy recommendation and for communication with society.

UNESCO and ICSU are currently doing follow-up on the progress since the Budapest Conference Declaration and Science Agenda.

1.1.2.3 Policy Trends in the United States and Europe

(1) Trends in the United States (Proposals for the Direction of Science and Technology Policy after the End of the Cold War)

In the United States, President Bill Clinton in February 1993 announced "Technology for America's Economic Growth – A New Direction to Build Economic Strength," shifting the direction of science and technology policy from military research to civil research in order to strengthen economic competitiveness.

Science and technology policy in the United States following the World War II, while at times shifting emphasis with changes of administration, is said to have been basically shaped by a report issued in 1945 by Vannevar Bush, head of the wartime Office of Scientific Research and Development, entitled "Science: The Endless Frontier" (popularly known as the "Bush Report"). The report listed the sectors of science research activity that should be supported by the federal government, including military research, public health, and medical science, and also argued for an emphasis on basic research, asserting that government support for basic research would be linked to the growth of industry.

Later, in September 1998, the U.S. House of Representatives Committee on Science released a report on U.S. science and technology policy in the 21st century, entitled "Unlocking Our Future: Towards a New National Science Policy," in which a proposal was made to shift to a science and technology policy that focuses on society.

The House of Representatives Committee on Science report revealed a recognition that, with the Cold War between East and West now over, there was a need to shift away from the previous emphasis on strengthening military power to a science and technology policy that aimed for strengthening economic competitiveness, to ensure that the United States would be able to maintain a leading role in the midst of economic globalization. The report listed four main goals for science and technology policy in the future, including national security, health, the economy, and support for decision-making, and revealed what policies the federal government should take to achieve those goals, as well as the responsibilities of the state governments, universities, industry, scientists, etc.

Items meriting particular emphasis included:

i) Promotion of basic research
ii) Application of scientific and technological results to new industrial technologies, and to societal and environmental problems
iii) Improvement of science education, and

emphasis on dialogue between scientists and the people

Regarding the last point, the report particularly focused on the improvement of science and mathematics education for children age 12 and under, and called for increased communication between scientists and technologists and the people, with specific recommendations as follows:

- To build bridges between scientists and journalists, scientists should be required to take courses in journalism and communications before graduation, and journalists should be given the opportunity to take science writing courses
- Researchers and technologists with skills for communicating with ordinary people should be given time to work on communications, in addition to their regular research activities
- Plainly worded summaries of government-funded research results should be prepared for publication, or placed on the Internet, so that a wide range of ordinary citizens can acquire the information

Later, in February 2001, the United States Commission on National Security/21st Century, a bipartisan group of people with legislative experience, announced the "Road Map for National Security: Imperative for Change" report, which featured proposals for U.S. security strategy through 2025.

The report, working from the assumption that the true source of national power and wealth lies in science and technology and in advanced education, and arguing that the United States needs to maintain its leading position in the world, emphasizes the importance of science and technology to U.S. national security, and makes proposals for the federal government to double its outlays for research and development, and to expand science and technology education.

(Federal Government Response to Societal Issues)

After the multiple terrorist attacks of September 2001, expectations rose for the utilization of advanced science and technology in response to the people's security and emergency situations. In this regard, the community of scientists is making proposals to the government. In June 2002, the National Research Council (NRC) issued a report titled "Making the Nation Safer: The Role of Science and Technology in Countering Terrorism." The report featured an announcement of the determination of the U.S. science community to respond to terrorism, showed the direction of anti-terrorism research and development from the short-term and long-term perspectives, and proposed the establishment of a strategic security institution, which culminated in the establishment in January 2003 of the U.S. Department of Homeland Security (DHS). To promote utilization of science and technology, the Homeland Security Advanced Research Projects Agency (HSARPA), was established within the DHS for comprehensive implementation of everything from basic research to development related to homeland security.

Again, in response to the anthrax incident of September 2001, the Public Health Security and Bioterrorism Preparedness and Response Act was passed in June 2002, to position research into bioterrorism countermeasures as an important sector for government research and development, and R&D is now going ahead at the National Institutes of Health (NIH) and elsewhere.

Elsewhere, the National Nanotechnology Initiative (NNI) was established in the year 2000 for the nationwide promotion of research and development into nanotechnology, a sector where competition has become fiercer around the world. It was further bolstered by the passage of the 21st Century Nanotechnology Research and Development Act in December 2003. While progress in research and development for the nanotechnology sector is expected to have a huge impact on both the economy and society through the creation of new industries, it is also recognized that its impact on society must be taken into consideration when applications are made, in much the same way as the bioethics issue has shaped the biotechnology sector. And while research on nanotechnology's impact on society has been pursued since the NNI was launched, the new law mandates that research and development take into consideration ethical, legal, environmental, and other society-related issues.

In the United States, expectations for science and technology tend to rise higher each time a societal issue becomes apparent, and development of responsive policies from the perspective of science and technology being accepted and utilized by society is now in progress in various sectors.

(Expansion and Strengthening of Science Education and Promotion Activities)

In the United States, as was also indicated in the reports issued by the House of Representatives Committee on Science and the United States Commission on National Security/21st Century, expansion of science and technology and education is recognized as being most important for laying the foundation of the nation. On the other hand, public opinion surveys reveal a serious situation in which people are becoming more distant from science and technology and student skills in science and mathematics are deteriorating (Table 1-1-22).

Table 1-1-22 Increased distance from science and technology in the United States

<Public understanding of science and technology>

- News about science attracts little interest from the public.
- The number of people who feel adequately supplied with information about science and technology is relatively small.
- About 70% of Americans do not have a clear understanding of the scientific process.

<Achievement in mathematics and science in primary and middle school education>

- Academic achievement of U.S. students in science and mathematics tends to decline against international norms at higher grade levels.
- The gap in student academic achievement in mathematics between low-income and high-income groups is widening.

Source: U.S. National Science Foundation (NSF). “Science and Engineering Indicators 2002”

In response to this situation, the federal government is placing more emphasis on education policy. Immediately after George W. Bush reached the presidency in January 2001, he announced a comprehensive education reform plan under the name of “No Child Left Behind,” which was followed in 2002 by revisions to the primary and middle school education laws, to mark a series of policies intended to boost academic skill levels.

In mathematics and science education-related areas in particular, the Mathematics and Science Partnership Program was instituted in FY2002, whereby scientists and engineers at research institutions and higher education institutions cooperate with primary and middle school institutions to improve mathematics and science learning in primary and middle school education. The program also seeks to promote greater understanding by building new science halls and museums, or adding to existing ones, and by expanding exhibitions, to boost the people’s literacy regarding science and technology.

(2) Trends in the United Kingdom (Long History of Activities for the Promotion of Scientific Understanding)

The United Kingdom is a country with a long history of science and technology activities, having established a state level academy of science, the Royal Society, way back in the 17th century. Moreover, activities to boost understanding of science and technology in society date back to the 19th century.

In 1799, The Royal Institution of Great Britain was established, followed in 1825 with the commencement of the “Friday Evening Discourse,” a weekly meeting held every Friday evening that was designed to boost understanding of science and technology among ordinary people, and to which the world’s greatest scientists were invited to lecture. This lecture series has continued down to the present day, and in recent years even scientists from Japan have been invited, including a 1997 lecture by Sumio Iijima, famed as the discoverer of carbon nanotubes, and a 2000 lecture by Masao Ito, who is known for brain science research.

In 1831, the British Association for the Advancement of Science was established for the promotion of science and for sharing scientific knowledge. While its activities at first mainly focused on exchanges between researchers, the association's activities today are mainly focused on promoting understanding among people. Every year in spring and fall the association hosts a festival and discussions where researchers come into contact with the people, to promote communication between researchers and the people.

(New Policy Directions Related to Activities for the Promotion of Understanding)

As can be seen, the United Kingdom has for many years been actively engaged in disseminating science and technology among the people. In recent years, however, a number of societal issues regarding science and technology have arisen, including problems related to gene recombinant technology and bioethics, and to Bovine Spongiform Encephalopathy (BSE). These new issues are beginning to shake the people's trust in science and technology, and the people are starting to disassociate themselves from science and technology. According to a public opinion survey conducted in January 2001 by the Wellcome Trust, three out of four respondents expressed perplexity at scientific progress, while two out of three respondents thought that science and technology were being used to promote human life, medical issues, and health.

In regards to this situation, the United Kingdom House of Lords Select Committee on Science and Technology released a report in February 2000 entitled "Science and Society."

The report summarized the problems attendant with promoting increased understanding of science and technology among the people, and listed some necessary policies. The report also indicated the need for two-way communication between researchers and the people, to wipe away the people's lack of trust in science in recent years (Table 1-1-23).

Table 1-1-23 General topics for promoting understanding of science and technology in the United Kingdom House of Lords Select Committee on Science and Technology report, "Science and Society"

○ Five general topics

1. Creation of a new culture of dialogue between scientists and the people is needed.
2. Careful attention to the people's values and attitudes is needed.
3. The people's trust in scientific advice for the government has been shaken, and an urgent response is needed.
4. All institutions offering advice in the science and technology sectors, and engaged in policymaking, need to take more open, transparent approaches.
5. Constructive, mutually cooperative relationships between scientists and the media are needed.

Source: United Kingdom House of Lords Select Committee on Science and Technology. "Science and Society"

The United Kingdom has a concept for focusing on the relationship between science and society, called "Public Engagement in Science and Technology (PEST)." This concept calls for two-way dialogue between scientists and the public for the purpose of deepening mutual understanding among scientists, policymakers and the public.

While the term previously used in the United Kingdom to describe this dialogue was "Public Understanding of Science (PUS)," the original meaning of "public understanding" had tended to become lost as scientists engaged in one-way activity to teach the public about science. In other words, society's strongly hostile reaction to the occurrence of problems in the relationship between scientists and society hinted at a lack of public understanding of science. Development of the PEST concept came about in response to the previous lack of success as things stood, and to the prospect of increasing distrust of science and technology.

In the United Kingdom, promotion of activities under this concept is intended to boost the public's interest in and awareness of science. For example, researchers provided with government research funding are either required or strongly encouraged to engage in activities boosting public understanding of their research results, and their research funds may be allotted for such activities. Furthermore, the Research Councils that distribute the research funds (seven Research Councils have been established for the various academic sectors) provide support activities for researchers so that they can implement the lectures required for communication with the public, and researchers are becoming increasingly aware of the need for mutual understanding with the public.

In a speech made in September 2002, Lord Sainsbury, the Minister for Science, said that "it is not enough for the public to understand science, the scientist also needs to understand the public. Moreover, debate should not be limited to the science itself, but should also include the benefits, risks, and value of science, and its effects on our lives."

As can be seen, there has been a great shift in thinking about science in the United Kingdom, with more aggressive efforts to implement a dialogue between scientists and the public so that the public relationship with science and technology results in two-way communication, toward the goal of building a new relationship between science and technology and society.

(3) Trends in France

In France, a number of societal issues in science and technology have become apparent in recent years, including the bioethical problem and the nuclear power issue, etc., and a public opinion survey conducted in November 2000 revealed that people are growing more distant from science and technology. In response to this situation, the government is actively promoting more understanding of science and technology among the people, and various policies related to science education.

A representative example of a policy for promoting increased understanding of science and technology in France is the "Science Festival." This program, instituted in 1992, uses exchanges between the people and researchers to deepen the people's understanding of researchers and of science and technology, and to help them possess essential knowledge, and its purpose is to ensure that the people can learn enough scientific knowledge to be able to participate in debates about problems arising from scientific and technological progress.

In 2002, more than 2,000 events were held in more than 750 different cities, towns, and villages, with participation from about 5,600 researchers. The events attracted a total of about 1 million people (of whom about 250,000 were students).

Moreover, in response to the people's increased need for scientific and technological information, a program was launched in FY2003 to deepen mutual exchanges and build cooperative relationships between researchers and the journalists who can provide information.

In January 2004, researchers resisting the government's freeze on the science and technology budget and proposal of reductions in lifetime employment posts at public institutions prepared a petition demanding reform from the government. This petition circulated far beyond the confines of researchers and was signed by many ordinary citizens as well as researchers, revealing the people's strong interest in the topic.

The government is moving toward enactment of a Basic Planning Law for Research sometime during 2004, in preparation for policies to boost research and development investment, and to promote research and development, and is at the present time engaged in a people's debate with many of the relevant parties toward the law's adoption.

(4) Trends in Germany

In Germany, the "Science in Dialogue" initiative was launched in 2000, based on recognition of the increasing importance in knowledge-based societies of mutual understanding between science and technology and the people. In this initiative, one science sector is selected each year for dialogue, and activities are conducted throughout the year to increase the people's understanding of science and technology (the theme for 2004 is "technology").

Elsewhere, the "FUTUR" project was launched in 2001 to promote research and development in response to the needs of society. This project is operated in reverse to the conventional method of forecasting the effects of science and technology on society, by instead forecasting future changes in society or new societal demands, and then searching out what kind of science or technology will be required in response. Discussions were not limited to researchers and specialists, but were opened widely to participation from industry, students, and ordinary citizens. In February 2002, the four areas shown below were selected as visions for guiding society, and specific research projects are now in progress:

i) Elucidate the thought function
ii) Open the door to the future learning society
iii) Enjoy energetic lifetime health through prevention
iv) Life in the Internet society: Individuals andsafety

The "FUTUR" dialogue programs are continuing to add additional areas for discussion.

(5) Trends in the European Union (EU)

With the introduction of a common currency in 1999 and the admission of 10 new members in May 2004 to create a 25-nation structure, the European Union (EU) is increasing its presence in the world economy and society. In recent years, the EU has seen increased activity to rebuild relationships between science and technology and society.

(EU Science and Technology Policy in Recent Years)

At the present time, the basic policy for science and technology in the EU is a document titled "Towards a European Research Area (ERA)" that was announced by the European Commission in January 2000. In the same way as the unified market and currency in the economic sphere, the document aims for the establishment of the so-called "single European market" through increased consistency of research activities and policies in the scientific and technological sectors, and formulation of an EU science and technology policy based on the document is currently in progress. The document looks at the problems of science and society in terms of the European dimension.

Immediately after the above policy was revealed, a comprehensive strategy for economic and social policy over the next 10 years was established at the EU council meeting held in Lisbon in March 2000 (the Lisbon Strategy). The summit leaders set a goal to establish the world's most competitive knowledge-based economy in the EU within the next 10 years, and recognized the need for building ERA toward realization of that goal. Moreover, they positioned science and technology policy as an important sector within the Lisbon Strategy.

(State of Public Opinion in the EU in Regards to Science and Technology)

A public opinion survey regarding the people's interest in science and technology (Eurobarometer 55.2) was conducted in the EU in 2001, and the results revealed the peoples' complex attitude toward science.

According to results from the survey, people in the EU show a generally positive understanding of science and technology. But while they hold high expectations, they do not believe that science and technology can be a universal cure-all for resolution of all problems. Moreover, interest in science and technology showed a slight drop compared to 1992, revealing that some of the people are becoming more distanced from science and technology.

A little closer look at the 2001 results revealed that more than half of the people in the EU have no interest in science, while more than 60% believe that they are poorly supplied with information about science and technology.

On the other hand, about 80% of respondents expressed belief that science and technology can conquer such diseases as cancer or AIDS, and about 70% thought that science and technology can make their own lives more comfortable.

In addition, with such problems as BSE lurking in the background, about 90% of respondents believe that scientists should be more forthright about providing the people with information about possible risks arising from scientific and technological progress, and should communicate their own knowledge more effectively. Moreover, 70% of respondents thought that politicians should place more trust in the opinions of scientists.

(Development of Policies Related to Science and Technology and Society)

The European Commission, recognizing the necessity for building a new relationship between science and technology and society, announced the "Science and Society Action Plan" in December 2001, toward construction of the ERA. The action plan offered the following three strategic goals:

i) Disseminate a science education culture throughout the EU
ii) Achieve a science and technology policy that is close to the people
iii) Position reliable science at the center of policy proposals

To achieve these strategic goals, 38 action plans have been proposed for joint action by scientists, policymakers, industrialists, and other interested parties in society at the EU level, the member country level, and the regional level (Table 1-1-24).

Table 1-1-24 Overview of "Science and Society Action Plan (2001)"

Strategic Goal No.1 Dissemination of science education culture throughout Europe
- (1) Public awareness (10 items)
- (2) Science education and careers (8 items)
- (3) Dialogue with the people (3 items)

Strategic Goal No.2 Achievement of science and technology policy that is close to the people
- (1) Participation of the people and society (2 items)
- (2) Achievement of gender equality in science (4 items)
- (3) Research and forecasts for society (1 item)

Strategic Goal No.3 Positioning of reliable science at the center of policy proposals
- (1) Ethical direction for science and new technologies (6 items)
- (2) Risk governance (1 item)
- (3) Utilization of specialists (3 plans)

Source: European Commission. "Science and Society Action Plan"

Elsewhere, the Framework Program (FP) launched in 1984 forms the core of EU science and technology policy. FP, a joint research and development program implemented by the European Commission, handles proposals for public bidding projects made by the European Commission for the realization of EU policy, and provides assistance for projects that meet its criteria. The Sixth Framework Program (FP6) is currently in progress, and the FP6 contribution to building the ERA consists of the following three pillars:

i) Merge research activities in the EU (7 priority sectors)
ii) Build the ERA
iii) Strengthen the foundations of the ERA

Within these categories, programs related to science and technology and society include one program in i) above titled "People and Governance in the Knowledge-Based Society," which is a priority sector, and "Science and Society," in ii) above, which is one of four special programs for building the ERA. Here, three sectors (1. Realization of research close to society, 2. Application of responsible research to science and technology, and 3. Stronger role for women in science, and in the dialogue between science and society) have been set as objectives for the development of structural links of actions related to the dialogue between the community of scientists and society.

As can be seen, science and technology policy is positioned as an important sector in the EU and, recognizing that the people's understanding of and participation in science and technology are essential for the promotion of this policy, the EU member states and related institutions are promoting efforts to build new relationships between science and technology and the people.