Full Research in Society,
for Society

AIST Report
2018

Social and Environmental Report

AIST

CHARTER

Full Research in Society, for Society

National Institute of Advanced Industrial Science and Technology (AIST), An Independent Administrative Institution

The common goal of humankind is to realize a society in which every person can enjoy a comfortable life. Science and technology can lead the way to such a society. The mission entrusted to AIST and its staff, as members of the scientific community, is to develop science and technology that complements society and the environment.

We, the staff members of AIST, recognize our mission and responsibility to society. We work towards the realization of such a society through research and development in industrial science and technology.

Accurate Assessment of Social Trends

We endeavor to ascertain social trends and needs at every level of society from local communities to the international stage, to identify key issues promptly, and to propose scientific and technological solutions in collaboration with other organizations.

Creation of Knowledge and Technology

We value each person's autonomy and creativity and display our collective strength through collaboration and synergy, creating new knowledge and innovative technology based on advanced research efforts.

Application of Research Findings

We contribute to Japan's industrial development by applying our research findings to academic pursuits, intellectual infrastructure development, technology transfer, and policy proposals. We endeavor to enhance and disseminate science and technology through human resources development and the open sharing of information.

Responsible Conduct

We are actively involved in improving our own abilities and our working environment in order to perform our duties more effectively. We respect both the letter and the spirit of the law and maintain a strict sense of ethics in all our affairs.

Charter of the Environmental Safety

- **We strive to promote research activities that contribute to the global environmental protection and the security of mankind and pursue our work to realize a safe and reliable society of high quality of life harmonious with the environment.**
- **In compliance with the applicable laws and regulations related to environmental protection, we establish the autonomous standards of the institute such as Safety Guideline, etc. and with this in mind, we shall endeavor to conserve environment and promote health and safety at all times.**
- **We promote the dissemination of information related to the environmental protection and make every effort to be in harmony with and coexist with the local community. Naturally, in case of disasters or emergencies, we take prompt and proper measures to deal with the situation.**

Furthermore, in conformity with the 'principles of disclosure,' we shall endeavor to return the knowledge acquired and accumulated to society.

Editorial Policy

The National Institute of Advanced Industrial Science and Technology (AIST) first published an environmental report in fiscal year (FY) 2004. Since FY 2010, AIST has published the AIST Report, which is an environmental report combined with a report on its activities on corporate social responsibility (CSR).

AIST Report 2018 Social and Environmental Report provides easily comprehensible introductions to research activities of particular interest to society, including a special article on the National Metrology Institute of Japan (NMIJ)'s involvement in the redefinition of the kilogram, an urban mining system for a circular economy, development of new drugs to hold back deadly infection, and a new theory on the movement of the Japanese archipelago. AIST Report also describes AIST's work on technology transfers to effectively provide the fruits of AIST's technological research to industry. Through this content, we hope that our many stakeholders will understand AIST's diverse activities and that a deeper relationship of trust will be built between AIST and society.

AIST's official website :
www.aist.go.jp/index_en.html

☐ **Activities covered by the report**
Research activities at all AIST research bases

☐ **Period covered by the report**
April 2017 to March 2018

☐ **Areas covered by the report**
Key areas covered include organizational governance, human rights, labor practice, fair operating practice, community involvement, environmental report, occupational health and safety and open innovation activities.

☐ **Rounding of numbers**
Numbers are rounded off to the specified whole number.

☐ **Referenced guidelines and other sources**
- 2012 Environmental Report Guidelines, Ministry of the Environment
- Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporations, etc., by Facilitating Access to Environmental Information, and Other Measures
- Guidance on Information to be Provided in the Environmental Report (3rd Edition), Ministry of the Environment
- ISO 26000: 2010 Guidance on Social Responsibility, Japanese Version, Japanese Standards Association

☐ **Scheduled date of the next edition**
September 2019 (Japanese edition)

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Top Message

Aiming for Compatibility of Industrial Development and Sustainable Society

— Playing a major role in Japan as an institute of multiple open platforms —

National Institute of Advanced Industrial Science and Technology (AIST)

President **Ryoji Chubachi**

Stunning progress is now being achieved in new technologies, such as artificial intelligence, robotics and the Internet of things (IoT); this progress is greatly improving and changing people's lives. Devices equipped with artificial intelligence that would have been thought the stuff of dreams a few years ago are appearing in our homes, and even practical self-driving technologies for cars are within reach.

The benefits of science and technology are making life more comfortable. On the other hand, the negative effects of industrial development are also becoming clearer. Around the world, we are seeing more of the climate change associated with global warming; Japan has experienced significant damage from record torrential rains and other consequences. This year's record-breaking summer heat, which is said to be an effect of global warming, is still fresh in our minds. How the development of science and technology can contribute to a healthy and stable society is now an issue in Japan and throughout the world.

In 2015, the United Nations adopted the Sustainable Development Goals (SDGs), setting 17 goals and 169 targets for building a sustainable society. Since the adoption of the SDGs, interest in the sustainable society has risen rapidly in many countries. Public interest in and expectations of the businesses, research institutes, universities and so forth who are responsible for developing science and technology are higher than ever.

Since AIST was established, we have been continuously active with the policies of developing in step with society and building a sustainable society, under the slogan "in society, for society".

AIST promotes seamless R&D from fundamental and basic research in non-competitive areas that are difficult for businesses to address to technological developments that can be commercialized and industrialized in cooperation with business, particularly focusing on research into environment, life, and information technologies.

In October 2016, AIST became a designated national research and development institute, together with the Institute of Physical and Chemical Research (RIKEN) and the National Institute for Materials Science (NIMS). With this designation, there is stronger expectation than before on raising the levels of science and technology in Japan and contributing to improvements in people's lives and to industrial development.

Today's Japan is facing a range of problems. It has been pointed out that the ability of Japanese companies to generate innovations has been weakening and their international competitiveness declining. The ability to build up new industries in fields such as the IoT and artificial intelligence is a major challenge for the future. AIST is overseeing research in various fields of industrial technology; Japan has many prospects in R&D of world class level. In the future, we must provide the fruits of these prospects to society efficiently and more widely, through collaboration and co-operative research with the companies and other organizations.

Japan is one of the world's most earthquake-prone countries and frequently suffers other natural disasters such as typhoons and torrential rains. Personal and economic damage from such disasters is substantial and disaster prevention measures are urgently required. Measures to deal with the degradation of public infrastructure, that was constructed in the period of rapid economic growth in the last century, are another major issue directly affecting people's lives.

Science and technology, by providing routes to solutions to the agendas facing society, creating new innovations, and producing next-generation industries, are a great driving force for continuing growth of Japan's economy.

I believe AIST should be a research institute of "multiple open platforms" driving R&D of world class level, conducting cooperative research with universities and other research institutes, and actively engaging in collaboration with business. We should both support industrial development in Japan and play a major role in building a sustainable society.

This report outlines our major research activities and our future research strategy. It also describes our efforts in many institutional matters: governance and welfare programs; staff training initiatives; support for a proper work–life balance; the promotion of diversity by means such as support for the participation of female staff and foreign researchers and the employment of people with disabilities; strengthening compliance; environmental safety management; and the establishment of fair business practices such as reasonable procurement.

AIST is improving its research activities, presenting them to society, and enhancing their transparency. In this way, AIST is raising the understanding of stakeholders, winning trust from society, and improving the effectiveness of its research.

We hope that you will understand our work and we look forward to receiving your continued support.

Opening Interview

- with Takashi Usuda -

Revising definitions in the International System of Units (SI)

The Challenge of a More Universal Kilogram: The Dream of Metrologists for a Century

In May 2019, the definition of the unit of mass (the kilogram), which is the global reference standard for weights, will be revised for the first time in 130 years.
As one of the base units of the SI, the kilogram is especially important. A number of countries contributed top-level technologies to the revision; AIST played a decisive role.
We asked Takashi Usuda, Director of the National Metrology Institute of Japan (NMIJ), why the new definition is needed and what has come from research into this unit.

The start of the SI: two prototypes

Whenever you measure something such as a length, weight, temperature or time, you need a reference standard. If the standard varies, the reliability of measurements is undermined. Therefore, people down the ages have searched for standards that will not vary.

Modern science, industry and daily life are underpinned by a common global standard, the SI. The starting point of the SI was the "international prototype of the metre" and the "international prototype of the kilogram" which were specified in 1889. The prototypes have since been carefully maintained at the International Bureau of Weights and Measures (BIPM) in France. The French government does not interfere with the BIPM. Even the Nazis, when they occupied Paris in the Second World War, did not interfere.

Takashi Usuda, Director of NMIJ, explains that European people saw the two international prototypes as a kind of Noah's Ark. Whatever catastrophe might occur, as long as measurement standards could be maintained, then it might be possible to rebuild civilization. There is a clear impression that measurement units are crystals of knowledge and must be very carefully protected.

Scientific progress needs accurate units

The definition of length was revised in 1960 and 1983; the prototype of the meter has already been retired. However, the kilogram prototype has continued in service for 130 years now. Usuda explains why the kilogram is being revised now.

"As science progresses, requirements for accurate measurement become increasingly severe; imprecision that was acceptable in the past can no longer be tolerated.

PROFILE

Director, NMIJ

Takashi Usuda

Ph.D. (Engineering), M.S. (Engineering) at Tokyo Institute of Technology, 1987. Joined the National Research Laboratory of Metrology (now AIST), 1990. Visiting researcher at Physikalisch-Technische Bundesanstalt (PTB) in Germany and Centre national de la recherche scientifique (CNRS) and Bureau international des poids et mesures (BIPM) in France. Member of the International Committee for Weights and Measures since 2012.

From time to time, the SI reviews its standards in response to the needs of society and more advanced science, and changes to more universal standards. In the case of length, the definition was changed from the metre prototype to a definition based on a physical constant, the speed of light. This improved measurement precision by a factor of about 1000.

In contrast, the definition of mass has not been revised in 130 years, because the required precision is very high and is technically difficult to achieve. The kilogram prototype is said to have changed by about 50 micrograms over that 130 years, about the mass of the grease in a single fingerprint. With the emergence of fields of science and technology dealing with tiny masses, such as nanotechnology, even tiny changes cannot be ignored.

Revising the definition of mass has been under discussion for a century and national metrology institutes in various countries have been conducting the R&D for about 50 years, but only in the last decade has a revision become feasible, leading to the upcoming redefinition."

The International Avogadro Project

The science journal *Nature* has listed the redefinition of the kilogram as one of the five hardest scientific challenges, on a par with detecting gravitational waves. How has AIST tackled this difficult question, known to be a dream of metrologists for a century?

Usuda explains that the definition of the kilogram has been worked on for half a century in Japan, since the days

of the former National Research Laboratory of Metrology. About 40 years ago, work began on precisely measuring the Avogadro number using the X-ray crystal density (XRCD) method employing silicon, the material that produces the most perfect crystals available. The idea was to count numbers of silicon atoms to determine masses. However, in the real world, silicon is a mixture of three stable isotopes, with atomic weights of 28, 29 and 30. With this obstacle, a measurement accuracy that surpasses the existing kilogram prototype could not be achieved.

In 2004, a number of countries launched the International Avogadro Project, working together to overcome this obstacle. In Russia, a nuclear fuel facility used special centrifuges to separate out the silicon-28 isotope, providing silicon-28 with a purity of 99.99%.

Extreme measurement precision at AIST

When ideal silicon was obtained, the goal suddenly looked more achievable. The different countries each brought their best technologies to bear, forming a monocrystal, measuring the lattice spacing, and creating a one-kilogram sphere. This is the most perfect sphere ever created by humanity.

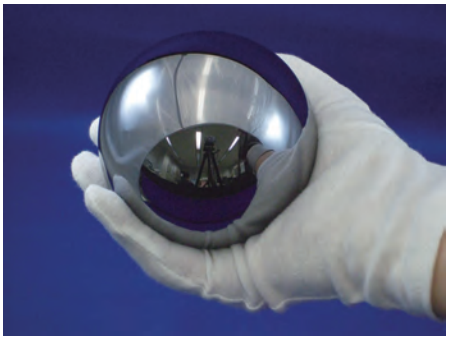
Then, at last, the mass and volume were measured. This is when AIST's advanced technologies came into effect.

Diameters of the sphere in about 2000 directions were measured using a superhigh-precision laser interferometer developed at AIST. Because silicon expands with temperature, technologies to precisely control temperature in a vacuum were employed, enabling a world-beating measurement accuracy of 0.6 nm. This incredible accuracy approximately matches the spacing between atoms (the lattice spacing). The volume was then calculated from the diameter measurements.

With a newly developed surface analysis system, a thin layer covering the surface of the silicon sphere (a film of oxides, etc.) was measured, and the mass and volume of the silicon object excluding this thin film were determined. In this way, the Avogadro constant was successfully measured to a world record accuracy of 2.4 parts in 100 million. From this, Planck's constant, another fundamental physical constant, was calculated.

Separately, Planck's constant was measured by a number of countries using a technique known as the Kibble balance. The Planck's constant values measured by the two methods matched.

Usuda adds, "Evaluation from multiple perspectives with different technologies and methods is important and allows us to verify that there are no omissions or errors. Combining cross-checking with discussions to bring everyone to a correct answer is the job of the metrologist."



The silicon sphere used to measure the Avogadro constant

Japan's prominent role in the SI redefinition

In 2017, eight datasets measured by national metrology institutes in different countries were submitted to the Committee on Data for Science and Technology (CODATA) and an updated value of Planck's constant was determined. The new definition of the kilogram is based on this value.

Of the eight datasets, four came from measurements AIST was involved with. Of these, three were contributed by the International Avogadro Project and one was data from new measurements at AIST.

"After the Meiji Restoration, Japan was slow to adopt the metre prototype and kilogram prototype systems that had been devised in Europe. In the 150 years since, however, science and technology in Japan have progressed to reach a level where we can contribute to the framework originally created in Europe."

The cutting-edge measurement technologies that led to this redefinition are real science, providing new knowledge to humanity. In any age, the best scientific technologies of the time are employed when setting a unit; this result is an excellent demonstration to the world of Japan's capabilities in science.

Revision of the ampere, kelvin and mole

There are seven base units in the SI system: the meter (length), the kilogram (mass), the second (time), the ampere (electric current), the kelvin (thermodynamic temperature), the mole (amount of substance) and the candela (light intensity).

In this revision, four units—the ampere, the kelvin and the mole along with the kilogram—are to be revised at the same time. Of these, the kilogram, the ampere and the mole are intimately related; when the definition of the kilogram is changed, the other two inherently must change too. The definition of the ampere is based on the elementary electric charge, and the definition of the mole is based on the Avogadro constant.

The situation with the kelvin is a little different. In simple terms, the old definition of temperature infers temperatures using states of water as reference points:

when water freezes and boils. However, this is a reversal of cause and effect. The reference should be temperature, and water should freeze and boil at certain temperatures. Accordingly, the kelvin will be defined on the basis of the Boltzmann constant, which is a common feature of both liquids and gases.

As mass is liberated from the kilogram prototype, temperature can be liberated from the physical substance that is water. After this revision, all seven of the SI base units will be expressed as formulas of physical constants.

Adoption scheduled for World Metrology Day 2019

Provided the new definitions are approved at the 26th General Conference on Weights and Measures (CGPM) in November 2018, the plan is to adopt the new definitions on the next World Metrology Day, which is May 20, 2019.

Usuda is one of the 18 members of the International Committee for Weights and Measures. These 18 discuss scientific issues and decisions relating to measurement standards and seek agreement from the CGPM, which all member states attend. The decisions of the CGPM constitute the history of units and standard references.

Asked how it feels to submit a historical SI redefinition to the CGPM, Usuda emphasizes that the redefinition is the result of many years of work: "The revision of a definition is the conclusion of cumulative tireless work by metrologists from the past to the present. Because a definition has great effects in the world, it must be agreed on by many countries. Bearing that in mind, it just happens to be now that all the pieces have fallen into place and it just happens to be me that is here. If the previous efforts of many people had been lacking in some way, the hurdles could not have been overcome."

The prospects: supporting nanotechnology

The redefinition of the kilogram has two major direct benefits.

One is that measurements of the same precision may be performed more easily and at lower cost. The procedure of periodically transporting the Japanese kilogram prototype that AIST cares for to France for checking will become unnecessary.

The other is that both tiny and huge masses can be accurately measured. Now, mass per atom can be accurately determined. Therefore, if a number of atoms can be counted, a quantity in grams can be calculated from the number of atoms and a mass can be measured directly. This is expected to be helpful in fields such as nanotechnology.

Usuda describes the prospects: "When instruments are developed using the new definitions, the scope of possibilities will be broader. For example, maybe a mass per inkjet drop in a printer can be measured and maybe individual microparticles of atmospheric pollutants can be evaluated. Measurement technology is fundamental for competitiveness; it affects every industry. It is also essential for building a sustainable society, through environmental analysis, drug discovery, food analysis and so forth."

The Japanese kilogram prototype

Inconspicuous revisions helping society

However, none of the new definition changes will be obvious to ordinary consumers. Usuda says that the correct way to implement a revision is cautiously, in a way that does not produce direct effects and goes unnoticed by most people. The present inconspicuous revisions are now being publicized through lectures, symposiums and press releases. Usuda is keen to tell high school students and others about the revisions; he is publishing texts for the ordinary reader, giving guest lectures and so forth.

"This revision of the SI definitions is a chance to think about how to use scientific knowledge to maintain a stable civilization. It is also a chance to look again at common knowledge that is rarely questioned. The big picture is interesting to me. I hope to nurture the motivation to consider new frameworks for the natural sciences."

As science and technology progress, unit definitions are changed; when unit definitions are changed, science and technology can progress further. AIST will continue to work with the rest of the world to support a civilization that can keep this virtuous circle turning.

01 Organizational Governance

Aiming to create an honest and transparent organization based on the principle of developing a sustainable society

AIST R&D in the Fourth Medium- to Long-Term Plan

Basic Policy for the Fourth Medium- to Long-Term Plan

This year was the midpoint of the Fourth Medium- to Long-Term Plan period that began in 2015. Activities in the fourth plan are based on the following basic policy to conduct world-class research and transfer the fruits of the research in accordance with the institutional image that we aspire to: "Through world-leading research taking account of the needs of society and industry, and transfers of the fruits of this research, contributing to the sustainable development of society with a focus on innovation and winning the trust of society."

Identifying strategic issues with consideration for the needs of society and industry

Through technology marketing activities, we are accurately identifying the needs of society and the needs of industry, strategically setting research topics, and flexibly modifying and creating research execution systems. For example, in order to conduct R&D that more closely relates to the strategies of business, we have set up nine collaborative laboratories in AIST branded with the names of companies, and are progressing with research in cooperation with these companies.

Driving innovation in the regions

At our regional research bases, we are identifying important research topics (headlines) in consideration of characteristics such as clusters of industries in those regions, conducting world-class R&D, forming relationships with public research organizations, learning about the needs of small and medium-sized enterprises, transferring technologies from AIST as a whole, and supporting local industries. We are currently working in 65 collaborations (such as contract research) with regional businesses.

Research system that can win strong trust from the nation's people

To continuously progress in research activities that can win the trust of business and society, and to ensure trustworthy research results and transparent operations, we are working to strengthen safety management and operations management systems, understand sources of risk and prevent problems from arising, and improve governance in the conduct of our operations. For example, we are reviewing our research notebook management system and working on more thorough management of research results.

Driving open innovation to combine know-how from Japan and other countries

We are actively working to bring many excellent technology seeds and personnel to AIST from universities in Japan and abroad and from public research organizations and businesses in Japan's regions, thereby improving AIST's research potential and driving open innovation as the heart (hub) of an innovation system for Japan. For example, we have appointed 176 innovation coordinators around the country, who are gathering the seeds of new technologies and cultivating human resources.

Training and welcoming people who will create innovation

With personnel systems that can make use of staff of different categories and ages and the introduction of systems to accurately evaluate their contributions to the institute, we are training and bringing in people who will create innovation. For example, we are inviting excellent researchers under the cross-appointment system (56 appointments in FY 2017) and the research assistant system (268 in FY 2017).

Seven domains of AIST

1. Department of Energy and Environment

To resolve energy and environmental problems

AIST has been working towards green innovation to resolve globally expanding energy and environmental problems through such technologies as follows: the use of new energies including renewable energies, energy saving technologies, high-efficiency energy storage, efficient use of resources, and evaluation/reduction of environmental risks.

2. Department of Life Science and Biotechnology

Realizing a healthy, active, aged society and creating a sustainable society

Anyone wants a long life in good health, and hopes to build a sustainable society by reducing environmental loads. To achieve such a society, we are contributing to life innovation by developing new technologies to evaluate health and to promote drug discovery, as well as to maintain, improve, and recover health according to individual conditions. We are also contributing to green innovation by developing technologies to reduce environmental loads using bioprocesses.

3. Department of Information Technology and Human Factors

Addressing social issues by interdisciplinary use and advancement of information technology to bring mutual prosperity to human life

Digital Data is becoming a critical part of life in modern society. To achieve a safe, comfortable, and prosperous future society, real-time access to and intelligent integration of data in both the cyber and physical spaces of society are key. Application of information technology to widely diverse fields in society can solve common problems. Furthermore, new value created by the integration of data provides new possibilities for communities and can transform society. We are contributing to the development of a sound society by specifically addressing the mutual interaction of informatics and ergonomics.

4. Department of Materials and Chemistry

Contributing to enhancement of industrial competitiveness by synergistic interaction between materials and chemical technologies

We are developing technologies to enhance added value of functional chemicals, and to realize practical use of new materials, with strengthening value chains of materials through synergistic interaction between materials and chemical technologies in mind. Thus, we are aiming to contribute to the primary materials and chemical industries.

5. Department of Electronics and Manufacturing

Enhancing industrial competitiveness through innovative technologies that lead varying manufacturing

We are contributing to enhancing industrial competitiveness by developing advanced electronic and optical device technologies that enable both performance enhancement and significant energy savings of IT equipment, and innovative manufacturing technologies that enable energy savings, resource savings, and low cost. Moreover, we are building a highly efficient production system by combining innovative manufacturing technologies and sensing technologies based on the advanced devices.

6. Geological Survey of Japan

Understanding of the Earth and coexistence with the Earth

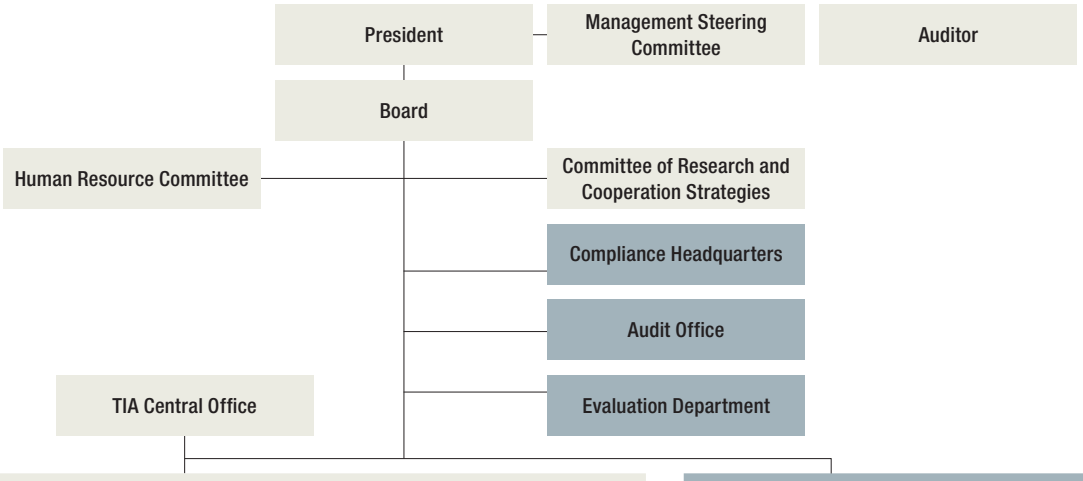
Geological information is essential for a country like Japan, located at a tectonically active area, to ensure a safe and secure society. We gather, compile, and provide geological information under the name of the Geological Survey of Japan (GSJ) and promote its wider use. We also develop technologies to overcome various difficulties in global environment protection, exploration of minerals and energy resources, and natural disaster mitigation, and coordinate international cooperation as a national representative.

7. National Metrology Institute of Japan

Development, dissemination, and use promotion of the measurement standards and development of the standards related to measurement technologies

As the national metrology institute (NMI), NMIJ focuses on development and dissemination of the measurement standards, promotion of effective utilization of the measurement standards, development of measurement technologies related to the measurement standards, legal metrology services and training of experts. NMIJ also maintains engineering, physical, material and chemical measurement standards while developing measurement and analytical instruments. Coordinating international activities on metrology standards is another important mission as a national representative.

AIST Organization Chart (as of June 1, 2018)



Department of Energy and Environment

- Research Institute of Energy Frontier
- Research Institute of Electrochemical Energy
- Research Institute for Energy Conservation
- Environmental Management Research Institute
- Research Institute of Science for Safety and Sustainability
- Research Center for Photovoltaics
- Renewable Energy Research Center
- Advanced Power Electronics Research Center

Department of Life Science and Biotechnology

- Biotechnology Research Institute for Drug Discovery
- Biomedical Research Institute
- Health Research Institute
- Bioproduction Research Institute
- Molecular Profiling Research Center for Drug Discovery

Department of Information Technology and Human Factors

- Information Technology Research Institute
- Human Informatics Research Institute
- Intelligent Systems Research Institute
- Automotive Human Factors Research Center
- Robot Innovation Research Center
- Artificial Intelligence Research Center

Department of Materials and Chemistry

- Research Institute for Sustainable Chemistry
- Research Institute for Chemical Process Technology
- Nanomaterials Research Institute
- Inorganic Functional Materials Research Institute
- Structural Materials Research Institute
- Interdisciplinary Research Center for Catalytic Chemistry
- CNT-Application Research Center
- Research Center for Computational Design of Advanced Functional Materials
- Magnetic Powder Metallurgy Research Center

Department of Electronics and Manufacturing

- Nanoelectronics Research Institute
- Electronics and Photonics Research Institute
- Advanced Manufacturing Research Institute
- Spintronics Research Center
- Flexible Electronics Research Center
- Advanced Coating Technology Reserch Center
- Research Center for Ubiquitous MEMS and Micro Engineering

Geological Survey of Japan

- Research Institute of Earthquake and Volcano Geology
- Research Institute for Geo-Resources and Environment
- Research Institute of Geology and Geoinformation
- Geoinformation Service Center

National Metrology Institute of Japan

- Research Institute for Engineering Measurement
- Research Institute for Physical Measurement
- Research Institute for Material and Chemical Measurement
- Research Institute for Measurement and Analytical Instrumentation
- Center for Quality Management of Metrology

Planning Headquarters

Research and Innovation Promotion Headquarters

Environment and Safety Headquarters

General Affairs Headquarters

AIST Tokyo Headquarters

AIST Tsukuba

Fukushima Renewable Energy Institute, AIST

AIST Tokyo Waterfront

AIST Hokkaido

AIST Tohoku

AIST Chubu

AIST Kansai

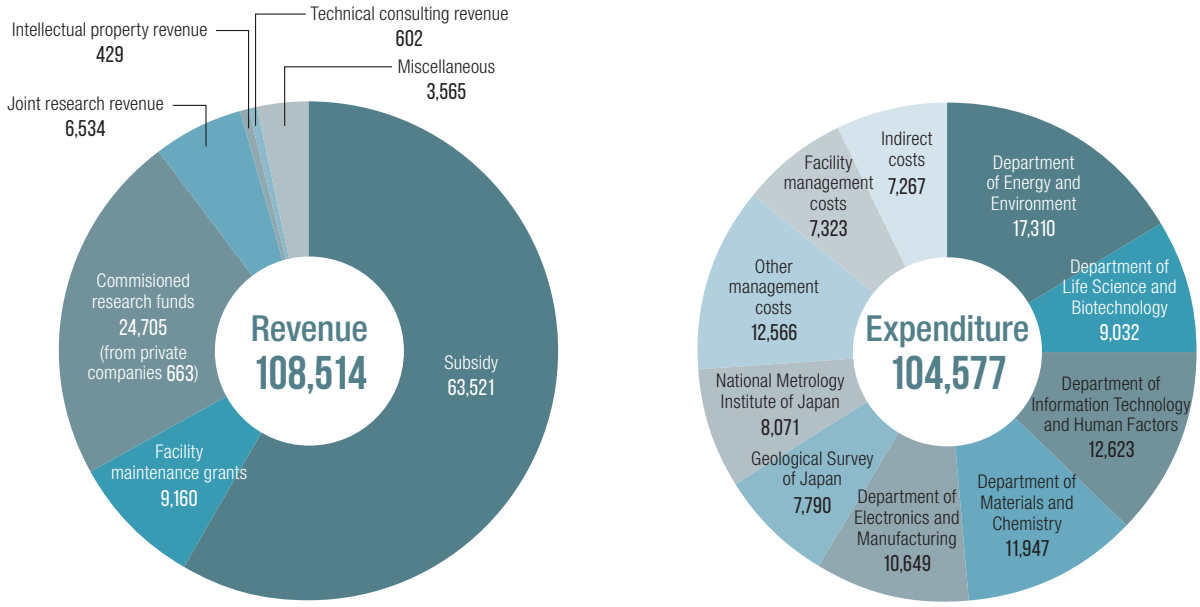
AIST Chugoku

AIST Shikoku

AIST Kyushu

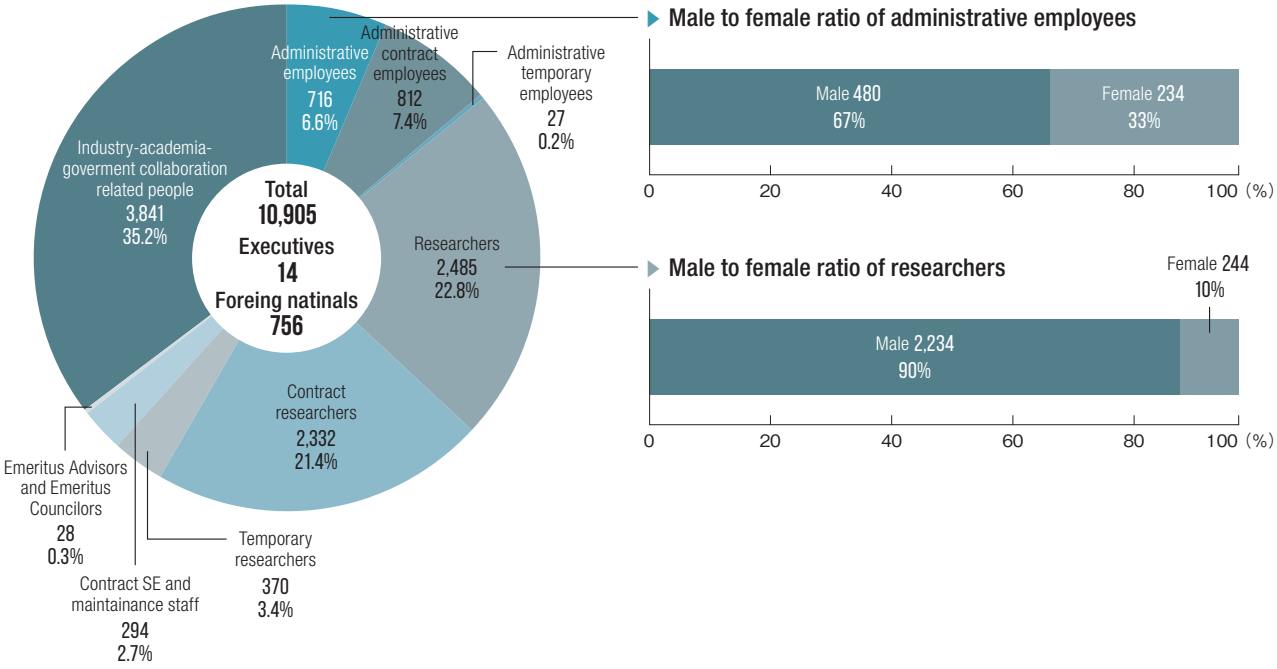
Revenue and Expenditure

Financial results for FY 2017 (unit: million yen)



Notes1 : Total may not become 100% due to rounding off.
Notes2 : The amounts of revenue and expenditure are adapted from the "Financial Statement" prescribed in Article 38 of the Act on General Rules for Incorporated Administrative Agencies.

Staff (as of March 1, 2018)



Promotion of Compliance

The Compliance Headquarters conducts AIST compliance activities and addresses research misconduct.

Compliance initiatives

To raise employee awareness of compliance and take our organizational culture to the next level, AIST undertakes the following measures to strengthen compliance:

(1) Every week, the Compliance Headquarters hosts a Compliance Promotion Committee meeting, primarily to report to the president on the risk information gathered from front-line employees and determine how to address it. Risk information is also shared at regular in-house meetings.

(2) Compliance Headquarters personnel provide on-site training at the research units of AIST Tsukuba and other regional bases. The main purpose is to emphasize the importance of compliance, introduce cases of misconduct, and explain clearly the causes and the caution that ought to be taken, in their own words face-to-face.

(3) In addition to on-site training, we provide compliance education as part of training for newly hired employees and management training for unit directors and research group leaders, with content adjusted to each group of participants.

(4) In an effort to instill compliance, we post monthly compliance posters titled “Compla dayori,” created under a different theme for each month. This is aimed at increasing employee awareness of compliance and urging them to be vigilant at work, in particular.

Addressing research misconduct

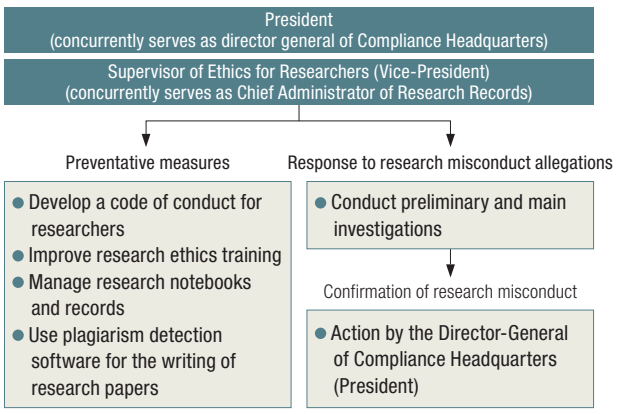
(1) In the event that research misconduct is alleged to have occurred, AIST handles the allegations rigorously in accordance with the Research Misconduct Rules and other guidelines.

(2) As part of on-site training at research units and management training for unit directors and research group leaders, the participants learn about research ethics, including compliance with the Code of Conduct for Researchers and how to prevent research misconduct.

(3) We have improved our research record-keeping practices and upgraded the system centrally managing research records, primarily to prevent falsification and ensure the authenticity of records even more effectively.

(4) We encourage employees to use the online plagiarism detection tool, which was introduced to help prevent inadvertent self-plagiarism and other forms of research misconduct. Its use has been increasing year by year, the number of times used being 483 in FY 2015, 725 in FY 2016, and 900 in FY 2017.

Response to research misconduct at AIST



Compliance partnerships with other entities

(1) In December 2017, the Association for National Research and Development Agencies created a Expert Committee on compliance with the primary aim of enhancing the risk management of the 27 member agencies. AIST played a central role in its creation.

(2) In February 2018, spearheaded by AIST as the secretariat, the first Expert Committee on compliance meeting was held, where the member agencies shared compliance information and discussed challenges and other matters.

Research record-keeping practices

As an institution conducting scientific and technological R&D financed by public research funds, AIST has been strongly called upon to take steps to prevent research misconduct—such as fabrication, falsification, and plagiarism—by the guidelines issued by the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Economy, Trade and Industry.

AIST has considered concrete measures to prevent research misconduct and ensure the integrity and transparency in research. As a result, we have introduced a variety of measures, which include obligating researchers to record research activities, setting rules of records management and of a supervisor confirmation process, and building a system that centrally manages these data (research notebook recording system).

In FY 2017 we improved our research record-keeping program, primarily by replacing the type of recording media from paper to electronic, and determining the

timing of the supervisor confirmation according to research progress. Likewise, the research notebook recording system was upgraded to accommodate these changes while enhancing security. These improvements were made from the perspective of raising operational effectiveness and efficiency.

AIST will continue doing its utmost to ensure the integrity and transparency in research so that the people of Japan can place greater trust in science.

Disclosure of Information and Protection of Personal Information

Disclosure of information

To increase the transparency of AIST's activities and fulfil its accountability requirements, AIST proactively discloses information on its website and by other means in accordance with the Act on Access to Information Held by Independent Administrative Agencies (implemented October 1, 2002).

Protection of personal information

In accordance with the Act on the Protection of Personal Information Held by Independent Administrative Agencies, etc. (implemented April 1, 2005), AIST has established a privacy policy and Rules on the Protection of Personal Information at AIST, to protect the individual's rights and interests while ensuring that activities at AIST are conducted properly and smoothly.

Every year, self-inspections for personal information protection and information security are conducted, to raise awareness of the proper management of personal information relating to executives and staff and of information security compliance.

Information disclosure desk and personal information protection desk

Requests for information disclosure in accordance with the Act on Access to Information Held by Administrative Organs and the Act on the Protection of Personal Information Held by Administrative Organs can be made through these desks and the website of AIST Tsukuba and other regional research bases. Each desk also provides help on the procedures for disclosure and personal information protection. Only requests for information disclosure can be made through the website.

Year-to-year numbers of requests for disclosure of information and personal information

FY	Information disclosure	Personal information
2014	9	2
2015	5	1
2016	3	0
2017	7	0

Emergency Communication Tree

AIST has created an internal emergency communication tree in order to respond swiftly to crises in Japan or abroad, such as terrorist attacks, hurricanes, floods, and serious risks that materialize on weekends or holidays.

Internal Audits

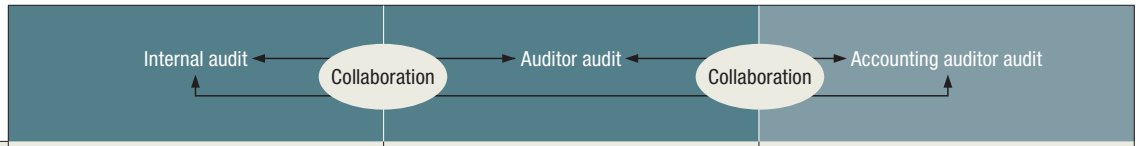
At AIST, the Audit Office is deemed an independent organ that reports directly to the president. In collaboration with the auditor and the accounting auditor, the office endeavors to achieve (1) effective and efficient work, (2) observance of laws and ordinances governing AIST operations, (3) preservation of assets, and (4) reliable financial and other reports. Toward these ends, the office monitors whether individual operations function properly and efficiently and, based on the findings, recommends improvements and other corrective actions. These internal audits are performed to support the auditees, not only by detecting and pointing out problems in work processes (i.e., problem finding), but also by suggesting effective improvements based on mutual understanding that is built through thorough discussion on the problems (i.e., problem solving).

In FY 2017, audits were performed concerning the following topics:

- As cross-sectional themes, information security and personal information management—themes that had been audited separately—were combined to undergo a single audit with the aim of reducing the auditee's burden while increasing audit effectiveness. The audit confirmed that these matters were generally being handled properly.
- As a theme focusing on a single project, Open Innovation Laboratories (OILs)* were audited. OILs are unique research units in that they are situated on university campuses. Taking this uniqueness into account, the audit looked into OILs' operational structures and infrastructure as well as their entire operations in a comprehensive manner. The audit confirmed that these matters were generally being carried out properly.
- As in the previous fiscal year, a comprehensive audit of research unit operations as a whole was conducted. While the audit confirmed that these operations were generally being carried out properly, it identified issues in terms of the compliance, effectiveness, and efficiency of some of the operations. The auditees concerned were advised to swiftly rectify the issues with improvements suggested. Follow-up audits were also performed to assess how the improvements suggested in previous internal audits had been implemented, and found that the improvements were being implemented properly.

*Industry-academia-government collaborative research bases situated on the campuses of seven universities (Nagoya University, the University of Tokyo, Tohoku University, Waseda University, Osaka University, Tokyo Institute of Technology, and Kyoto University). OILs are aimed at accelerating the enhancement of AIST's ability to facilitate technology transfer, by utilizing the promising technological ideas generated, and outstanding researchers working, at universities and other institutions that possess innovative basic research capabilities. In FY 2017, an audit was conducted at seven sites, consisting of the six OILs established in or before FY 2016 and a collaboration base located on Kyushu University's campus.

Collaboration in audits



	Internal audit	Auditor audit	Accounting auditor audit
Scope of audit	● Operational audit ● Accounting audit ● Compliance audit	● Operational audit ● Accounting audit	● Accounting audit
Points of audit	● Activities as a whole ● Appropriateness of risk management and development and operation of internal control systems ● Improvement of work process efficiency	● Activities as a whole ● Decision-making by the President ● Creation and operation of internal control systems ● Appropriateness of financial statements	● Appropriateness of financial statements (effectiveness of internal control systems)

Developing Advanced Recycling Technologies for Rare Metals to Build a Strategic Urban Mining System and Realize a Sound Material Cycle Society.

Principal Research Manager, Environmental Management Research Institute
Representative, Strategic Urban Mining Research Base (SURE)
Chairman, SURE Consortium

Tatsuya Oki

Japan is dependent on imports of many metal resources and is affected by concerns about price changes and reliability of supplies.
AIST has established the Strategic Urban mining REsearch base (SURE) and the SURE Consortium, an industry–government collaboration, to recover useful metals from the discarded electrical goods that can be found in cities and to put those metals to high-grade uses.
We are making increasingly rapid progress in world-leading R&D to build a sound material cycle society for the future.

A research base to connect arterial industries with venous industries

A decade ago, there was growing interest in urban mining—treating useful metals contained in waste goods such as domestic electronics as a mine—and there were hopes for urban mining to be a resource within Japan. However, two major problems with reusing metal resources have arisen. One is that almost all recovered metal is diverted to low-grade uses such as being mixed into concrete and roads without regard to the original value of the metal. The other is that, particularly in the case of rare metals, it is very difficult to extract and recover only the desired metals from mixtures to produce the refined raw material.

In response, AIST established the world-leading Strategic Urban Mining Research Base (SURE) to facilitate high-grade uses of recovered metals (horizontal recycling), making them resources as valuable to industry as natural metal resources, and to build the sound material cycle society. Tatsuya Oki of the Environmental Management Research Institute serves as a director of SURE. We asked him to introduce the organization.

“We launched a research group with three researchers

in 2011. By 2013, SURE had grown to 37 researchers over nine research units. To create the sound material cycle society that is our goal, connecting arterial industries (manufacturers and the like) with venous industries (recyclers and the like) was also essential. I traveled round the country for a year, learning the needs of businesses. I aggregated what I had heard and started an industry–government collaboration called the SURE Consortium, which now counts 86 businesses and public bodies as members."

To develop urban mining, SURE is working on the coordinated development of a range of technologies related to recycling, such as physical separation technologies, refining technologies, product planning that takes account of recycling, and forecasting of the potential of urban mining.

Automatic separation and recovery of useful metals

AIST has worked on the development of recycling technologies for many years, developing technologies for recovering magnets, tantalum, phosphors and so forth, and providing separating machines and numerous other products to society. Our rare metal recycling technologies are world leading; we also lead Japan in physical separation technologies and particular refining technologies.

With SURE as a solid base for research, these technologies have entered a new phase. Previous novel technologies were to extract only "metal A" from discarded electrical goods. What we are now seeking to develop is technologies that can automatically separate and recover many useful recoverable metals contained in discarded electrical goods—"metal A," "metal B," "metal C," "metal D" and so forth.

Oki adds, "Recycling businesses recover all the metals that they can separate,and store each metal that currently has a low market price until the price rises. This could be described as market-driven behavior providing storage for the nation. In addition, it naturally leads to stable supplies of metal resources. Although this is still a dream, I would like to build a system of this kind based on AIST technologies."

Fully automated systems for high-grade recycling

In June 2017, NEDO started a large project, "Technology Development on Low-Cost, High-Efficiency Metal Recycling." In June 2018, the SURE Center for Developing Separation Technology (CEDEST) was established to be a central research facility. Oki served as project leader, promoting collaboration between industry, academia and government in the development of automatic and autonomous recycling plants that can improve both the quality and labor efficiency of metal recycling.

"Our aim is to automate the disassembly and separation tasks that are currently conducted manually in recycling plants. If we can cut labor costs, recycling costs will fall, and our international competitiveness will rise. Each time a new domestic electrical product is released, the kinds of metal that are used and how they can be extracted change; so, the challenge is how to collect product information and help machines to make decisions. Currently, AIST is collecting product data and verifying how far recycling can be upgraded in the future by information being provided from manufacturers and the like."

The objective is to use equipment made in Japan to put metal resources from Japan's urban mines to high-grade uses and circulate metal resources within Japan. However, the recycling industry in Japan is made up of over 10,000 small and medium size enterprises. Wide uptake of even leading-edge Japanese-made technology will be hard; the ground has not been prepared for deployment. Accordingly, AIST through the SURE Consortium will mediate between arterial and venous industries to build recycling networks for society. The future that Oki portrays is one in which sound material cycle industrial systems, from which all related businesses can profit, are established.

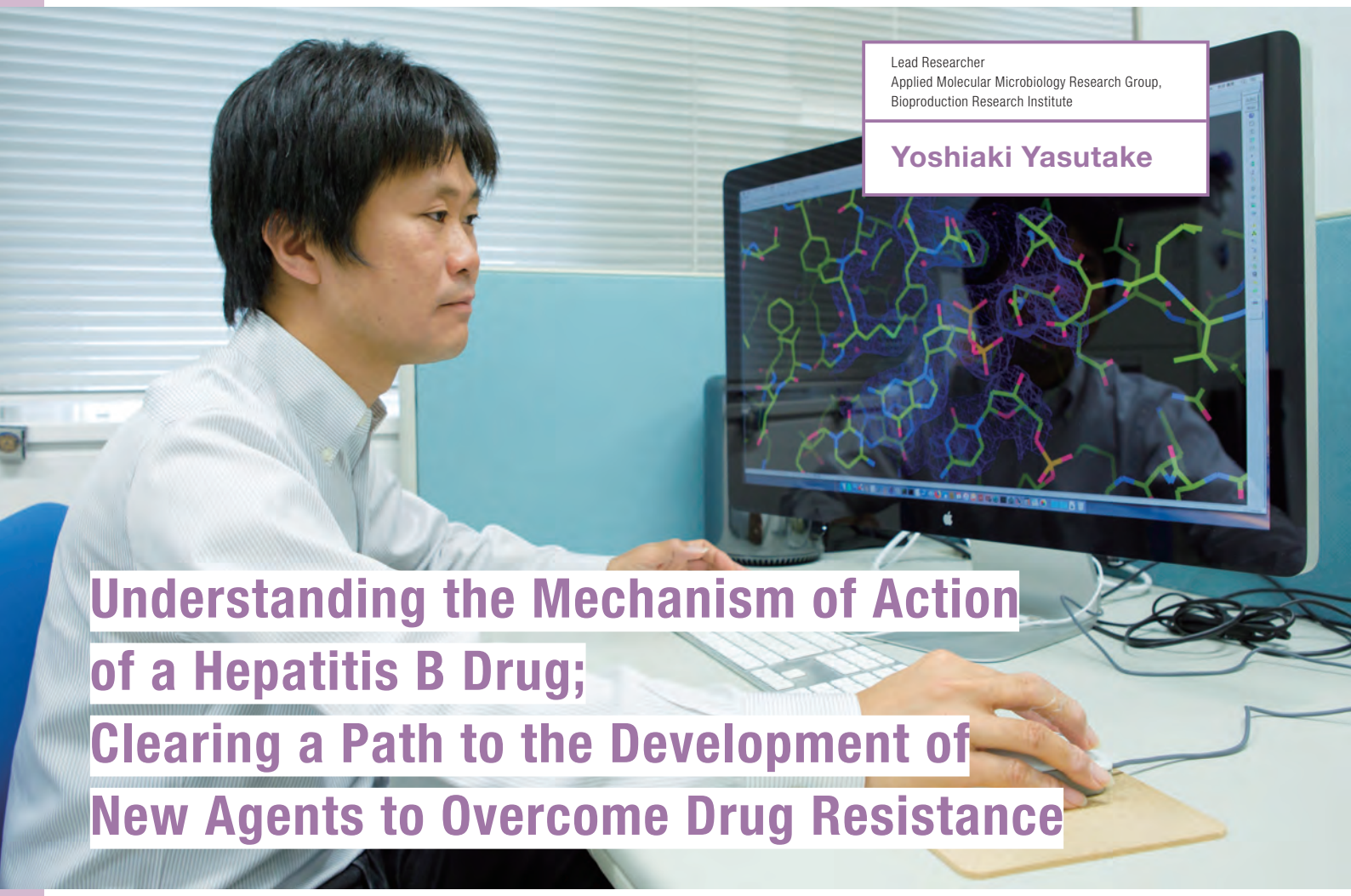
Demonstrating Japan's advanced technology to the world

We asked Oki what level of implementation he is aiming for. "First, I want to complete demonstration equipment that can process a limited range of items by 2020, to demonstrate Japan's advanced recycling technologies to the world. After that, I hope to build a test plant, and then scale up and commercialize."

Before practical implementation, there are still many problems to be overcome. A particularly high hurdle is expanding the range of items that can be processed. If the number of items can be increased, the number of types of metal resources recovered will increase. The need is to commercialize, at as low a price as possible, a compact system that, as well as using high-grade physical separation technologies, will fit inside recycling plants.

Oki affirms that, even considering global trends such as the SDGs set by the United Nations and circular economy proposals from the EU, creating a sound material cycle society will require progress by society as a whole. The SURE Consortium is steadily growing in importance and profile in facilitating this future.

Computer circuit boards classified by types of metal by an automatic separation system



Lead Researcher
Applied Molecular Microbiology Research Group,
Bioproduction Research Institute

Yoshiaki Yasutake

Understanding the Mechanism of Action of a Hepatitis B Drug; Clearing a Path to the Development of New Agents to Overcome Drug Resistance

Drug-resistant hepatitis B virus (HBV), against which previous agents are ineffective, has been reported and there are calls for the development of new drugs.
The first step has to be uncovering the mechanism of action of drugs and the mechanism of drug resistance.
AIST has borrowed features of the AIDS virus (HIV) to study reverse transcriptase in HBV and successfully analyzed the protein structure of the reverse transcriptase after the drug has acted on it. The results will help in the development of new drugs.

The many unknowns of HBV

Around the world, 260 million people are infected with HBV. Currently, completely removing all HBV DNA from the body is not possible; patients must carry on taking drugs for their whole lives. One of the drugs that have been widely used is a nucleoside analog treatment named entecavir. HBV that is resistant to this drug has been reported in recent years. Accordingly, AIST and the National Center for Global Health and Medicine are cooperating on research to develop a new drug that will overcome this resistance.

To develop this new drug, it is necessary to understand the mechanism by which the drug works and how the drug resistance has occurred. Yoshiaki Yasutake of the Bioproduction Research Institute is leading this research. Over many years, Yasutake has worked on structural analysis of various proteins and on improvements and modifications of their functions.

Yasutake explains that the object of this research is reverse transcriptase, a protein that is necessary for replication of the virus. HIV and HBV are notable as viruses with reverse transcriptase but, compared with that of HIV, there is much that is still unknown about the

reverse transcriptase of HBV.

"Research into HBV reverse transcriptase has not progressed because it is an extremely unstable protein and analyzing its structure has not been possible. In contrast, research into HIV reverse transcriptase has made progress and the results have contributed to the development of a currently widely used anti-HBV drug. However, we still do not understand in detail the mechanism of action of this anti-HBV drug on HBV reverse transcriptase."

Modifying reverse transcriptase from the AIDS virus

Analyzing the structure of HBV reverse transcriptase is a difficult matter; researchers around the world have attempted it in the past and got nowhere. Yasutake himself tried for nearly four years, quite fruitlessly. The breakthrough came with the use of HIV reverse transcriptase.

"The reverse transcriptases in HIV and HBV are quite different, but the active sites affected by drugs are relatively similar. I thought I might use HIV reverse transcriptase and make only the active site similar to that of HBV reverse transcriptase. A reverse transcriptase is a protein in which several hundred amino acids are linked together, but a drug acts on only one location. In HIV reverse transcriptase, I analyzed 20 amino acids within a certain distance from this HIV reverse transcriptase active site and found that eight of them were different from the amino acids in the HBV reverse transcriptase active site. I tried substitutions of these eight amino acids in HIV reverse transcriptase and found that substituting glutamine at a certain location with methionine made entecavir effective. In this way, I successfully made a modified HIV reverse transcriptase that imitates HBV reverse transcriptase."

Analyzing the modified reverse transcriptase structure in complex with a drug

Now the reverse transcriptase being studied could be made in large quantities. At last, the path to structural analysis had been cleared.

To investigate the mechanism of action of the drug, a state in which the reverse transcriptase is bonded to DNA had to be crystallized, which was also difficult. Molecular motion becomes complex when reverse transcriptase binds to DNA; so, crystallization is very difficult. Yasutake spent a year and a half on crystallizing the modified HIV reverse transcriptase. Then, he bonded it with entecavir triphosphate, the form that is active in the body, and analyzed the protein structure at high resolution using synchrotron radiation equipment (Photon Factory) at the High Energy Accelerator Research Organization.

The results revealed entecavir's mechanism for bonding to reverse transcriptase and preventing replication of the virus, and the mechanism by which drug resistance occurs. These results will be invaluable for designing new compounds that fit to the active site, and are facilitating the development of new drugs by cooperating researchers.

A new drug contributing to healthy lives around the world

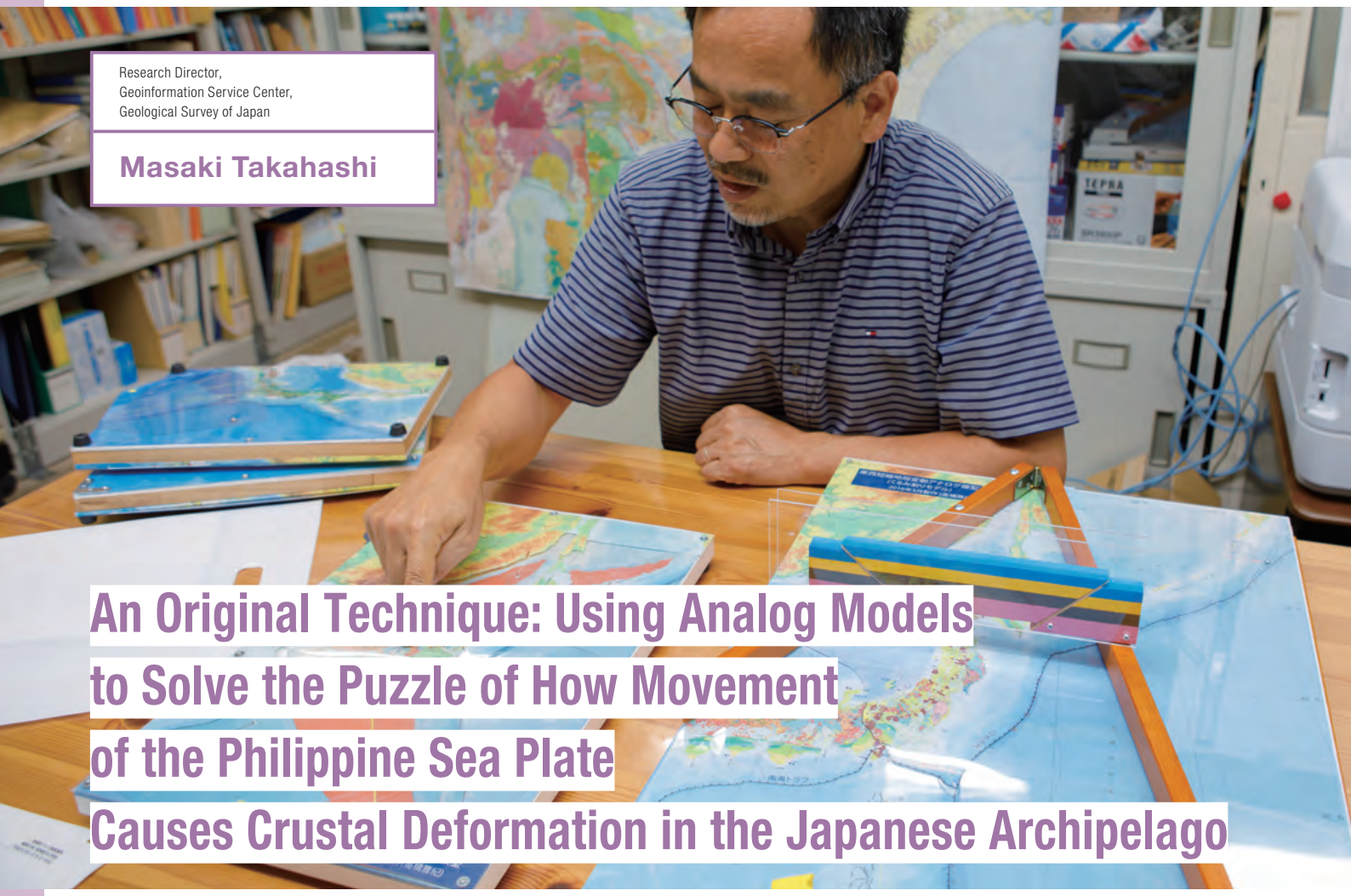
Many of the cooperating researchers are doctors. Yasutake has been greatly inspired by his interactions with researchers in different fields.

"As project leader we had Hiroaki Mitsuya, who was the first in the world to develop an anti-HIV drug. Many doctors familiar with the clinical frontline such as Yasuhito Tanaka, one of the leading hepatitis researchers, cooperated in the research. In a sense, my work narrowly targeting reverse transcriptase was 'looking at the trees and not seeing the forest,' but the doctors were looking at the forest, meaning HBV patients while conducting research. Consequently, we did not just chase after research results but had practical discussions, such as on a compound, no matter how effective, it could not be used as a drug if it was even a little cytotoxic. In the future, by broadening the choices for drugs, we should be able to overcome the problem of drug resistance and give drugs equitably to patients throughout the world. In the context of the SDGs established by the United Nations, I want to contribute to research that leads to healthy lives for human beings."

When Yasutake presents his papers, he receives emails directly from people affected by disease, telling him of their happiness on learning that research into drug resistance is progressing. His research results have now been registered in a database of protein structures and can be used by researchers throughout the world.

These results are the first step in studying the structure of HBV. For Yasutake, many questions still remain. One is how to make a modified HIV reverse transcriptase that more closely resembles HBV reverse transcriptase. Then there is finding the mechanisms of action of other drugs and other mechanisms of drug resistance. Moreover, a structural analysis of HBV reverse transcriptase is yet to be achieved by anyone anywhere.

He does not fear failure. His hope is that these challenges will lead to the development of the new drugs that the world is waiting for.



Research Director,
Geoinformation Service Center,
Geological Survey of Japan

Masaki Takahashi

An Original Technique: Using Analog Models to Solve the Puzzle of How Movement of the Philippine Sea Plate Causes Crustal Deformation in the Japanese Archipelago

The mountainous topography of the Japanese archipelago has been created over the past three million years by crustal deformation, being compressed from east and west.
AIST has presented a new theory with an impact profound enough to rewrite the earth science textbooks—that the east–west compression is caused by the Japan Trench moving due to movement of the Philippine Sea Plate.
Many puzzles in geology and seismology, such as the causes of inland earthquakes, can be unlocked by this single idea.

The moment the model was completed, the puzzle was solved

Three million years ago, the island of Honshu started to be pressed by strong forces from East and West, bodily raising the whole of Japan. This “east–west compression” is still continuing today.

For a long time, the east–west compression has been thought to be caused by subduction of the Pacific Plate moving westward. However, this movement of the Pacific Plate has continued virtually unchanged for 40 million years, but the east–west compression suddenly started three million years ago. Masaki Takahashi of the Geoinformation Service Center looked into this question, which has remained unanswered by geology for over half a century.

In research concentrating on the Philippine Sea Plate, which extends south from the Japanese archipelago, Takahashi came up with a unique research technique, conducting experiments using analog models.

The Earth’s surface is covered by many tectonic plates, each of which moves in a different way. For analog models of the edge of the Japanese archipelago, Takahashi cut out an oceanic plate (the Philippine Sea

Plate) and a continental plate (the Eurasian Plate), overlaid them on a base board (the Pacific Plate), fastened poles of turning (Euler poles) of the oceanic plates with pins, and experimented with moving the plates by hand.

"When I moved the model I made first, the trenches moved, but they are not supposed to move; thus, the model portrayed an impossible situation, with the Pacific plate shearing near the triple junction off the east coast of the Boso Peninsula (which is the only place in the world where three trenches meet at one point). After this, I went through a great deal of trial and error, adjusting the models to find credible movements. One of the things I tried was detaching the East Japan block from the Eurasian Plate. One day, I completed a model that moved in accordance with these limitations without breaking. In that moment, I had solved the puzzle of the crustal deformation of the Japanese archipelago.

When the Philippine Sea Plate moves northwest, East Japan moves west together with the Japan Trench and the crustal deformation of the east–west compression occurs at the eastern edge of the Sea of Japan. This is the answer that the model showed."

This shows that the cause of the east–west compression is not the Pacific Plate but the Philippine Sea Plate. We now have a new theory that neatly links the geophysics of plate tectonics with the geology of crustal deformation.

How movement of the Japan Trench causes inland earthquakes

The solution revealed by the analog models provides a single explanation for a number of questions in geology and seismology.

"The persistent inland earthquakes in eastern Japan can be explained by a hypothesis that a new plate boundary is forming at the eastern edge of the Sea of Japan, where many earthquakes occur, and strain is building up due to the east–west compression. Inland earthquakes occurring in western Japan, such as the Kinki region and Shikoku and Kyushu islands, are also caused by movement of the Japan Trench.

The large size of the landmass of Honshu is difficult to explain in geological terms, but makes sense if Honshu is both floating on the mantle and being forced upward by east–west compression. Seashell fossils found high in the mountains can also be explained by land that was on the seabed a few million years ago being lifted up.

Strain rates in the Japanese archipelago found by GPS measurements are an order of magnitude greater than strain rates calculated from geological principles. This discrepancy can be credibly explained by moving Japan Trench at 1 cm/year relative to the Eurasian Plate, as a cause of geological strain."

Over a decade of obstacles to publishing a paper

The truth is that Takahashi identified the cause of the east–west compression 15 years ago but only published a paper in 2017. Why did it take so long?

"Using my analog models, even school students could understand the idea, but it was very difficult for even specialists to understand when expressed only in text and maps. The response to my conference presentations was indifference, and the articles I submitted were rejected out of hand. I was resigned to taking the idea to my grave." Although the number of people who appreciated the idea gradually increased, including Seiya Ueda, a global authority on plate tectonics, no paper could be published. The situation only changed in 2017, when the idea was introduced on a television program about the natural sciences.

Just before the broadcast, an article was published in an AIST internal journal and mentioned in a press release. The article was later included in a special issue of a science magazine with the title "Theories on movement of the Japan Trench." The article's impact even extended abroad, with an offer from a publisher in the EU to turn it into a book.

Bringing the new geology to society

The results that have been presented are merely the start of the real research. The analog models Takahashi has made can unlock the geology of both the past and future, and will bring a constant succession of new findings. All of this will cause extensive rewriting of geology textbooks.

Takahashi has a theory: "When ideas that are different from the currently accepted concepts are presented, it is very hard for them to be accepted. This is because people reject things that they do not understand. As a result, only articles that can be understood are promulgated widely. But if only comprehensible articles that accord with the accepted wisdom are produced, this does not necessarily mean that the science is advancing. For science to advance, perspectives from outside the current paradigm must be presented. Therefore, researchers must have time to think thoughts that do not fall inside the paradigm, or in other words, time to 'free their minds'."The time Takahashi has spent immersed in making his analog models might be considered time that he could thoroughly free his mind.

The analog models have become an indispensible tool for outreach activities. Takahashi believes that research starts to have value when transmitted to society. He distributes easy-to-assemble paper model kits to the audiences of his lectures. When people can comprehend the crustal deformation of the Japanese archipelago, very advanced geological research results are being brought to society in a way that is easy to understand.

02 Promotion of Research Activities

AIST promotes research activities "in society, for society" with awareness of the role of industrial science and technology

Overview of AIST Consortiums

AIST Consortiums are thematic research groups formed and administered by AIST, with the primary aim of facilitating industry-academia-government collaboration, promoting the utilization of research findings, and gathering and providing information, in the fields relating to AIST operations. As of July 1, 2018, a total of 47 consortiums are in action, offering opportunities for business-to-business matchmaking and information exchange.

Artificial Intelligence Technology Consortium —an AIST Consortium

The Artificial Intelligence Technology Consortium was founded on May 1, 2015, the very date on which AIST created its Artificial Intelligence Research Center in the Department of Information Technology and Human Factors. The consortium aims to develop a mechanism that will continue making it possible to integrate AI technology into society and generate value through cross-sectoral co-creation. Sharing the strengths and challenges of nearly 200 member companies, the consortium is engaged in a number of initiatives, such as creating forums (working groups) in which to seek the best match for individual member companies, holding workshops on how to use AI technology and big data, sharing the latest trends, putting design thinking into practice, planning small projects, and organizing competitions. Drawing on extensive know-how amassed through these initiatives, the consortium has recently started participating in large cross-sectoral collaboration projects and government-led R&D programs while opening regional chapters. The consortium publicizes its findings through public symposia, major trade fairs, and other events in order for them to be widely used in society.

AIST consortium list

1	AIST関西懇話会
2	Digital Human Technology Consortium (DHTC)
3	Advanced Manufacturing Innovation Council
4	Standardization of Performance Assessment of Optical Non Contact Coordinate Measuring Machines Consortium
5	Green Process Incubation Consortium (GIC)
6	高濃度オゾン研究会
7	Research Consortium on Industrial Utilization of Wood-based Materials for Sustainable Development
8	名古屋工業技術協会
9	産総研バイオ材料コンソーシアム
10	Clayteam
11	安心安全電磁環境研究会
12	Tsukuba Society of Characterization and Analysis for Nanoelectronics
13	スマートコンビナート研究会
14	Medical Device Regulatory Science Working Group
15	Japan Advanced Printed Electronics Consortium
16	Smart Life Care Consortium
17	X線新技術産業化コンソーシアム
18	Graphene Consortium
19	Sensing Technology Consortium
20	Materials Evaluation System Technology Consortium for Low-carbon Living Space
21	ヒューマンロコモーション評価技術協議会
22	Nanocellulose Forum
23	Strategic Urban Mining Research Base
24	構想設計コンソーシアム
25	バイオマスリファイナリー研究フォーラム
26	Next Generation 3D Internal/External Metrology Consortium
27	AI Technology Consortium
28	Flexible Energy Device Consortium
29	製造業のサービス化コンソーシアム
30	Flow Science & Technology Consortium (FlowST)
31	Consortium for Evidence-based Health & Wellness Services
32	Precise Electric Measurement Consortium
33	Sustainable Remediation Consortium
34	Mechanoluminescent Technology Consortium
35	Technological Consortium Adhesion and Bonding (T-CAB)
36	環境水等の放射性セシウムモニタリングコンソーシアム
37	Consortium for Proficiency Testing on Pesticide Residue Analysis
38	Food, Medicine and Material Innovation Based on Bio-resource and Catalyst Technology
39	Initiative for Most Power-efficient Ultra-Large-Scale data Exploration
40	Internal Combustion Engine Consortium
41	Consortium for Human Resources Development of Geology
42	コールドチェーン・コンソーシアム
43	フォトバイオ協議会
44	Consortium on Glass Property Measurement for Manufacturing
45	外力支援型バイオアッセイ技術コンソーシアム
46	Silicon Photonics Consortium
47	Cyber Photonic Platform Consortium

NEC, AIST, and RIKEN Start Collaborating in AI Research

Accelerating the entire research and development process from basic technology development to commercialization

AIST engages in a wide range of R&D programs in partnership with corporations and universities.

December 2017, we reached an agreement with NEC Corporation and RIKEN on tripartite collaboration designed to unitedly accelerate the entire R&D process from basic technology development to commercialization. Focusing on two cutting-edge research themes in the artificial intelligence (AI) field, the three entities share R&D information, jointly develop software, and promote shared use of facilities and other research resources. Our collaboration aims to raise efficiency in translating component technologies into practical solutions, streamline activities by achieving higher-level consistency, and maximize research outcomes.

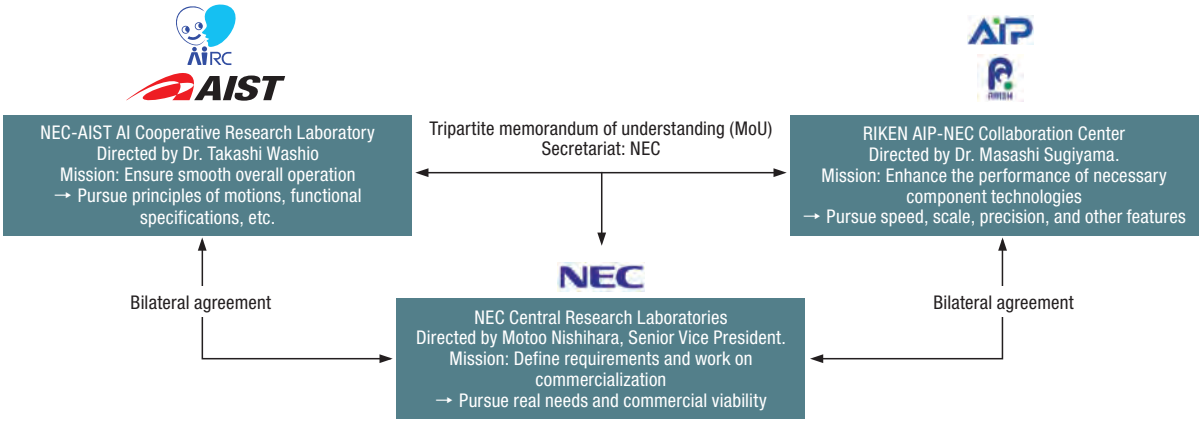
Research themes

Decision-making in unknown situations

People sometimes have to make a decision on matters that are too complex to comprehend. Our collaboration is to develop an AI technology that assists humans in decision making. An AI system with simulation ability will allow decision making under uncertainty and complexity.

Autonomous negotiation among AI systems

Our society will have a large number of AI agents, and sometimes their actions will create conflict with others. AI systems especially for social basic functions, such as logistics, transportation, and infrastructure must not stop due to conflicts or long negotiations, since their safety is crucial for us. Automatic, quick, and efficient negotiation ability to solve such conflicts is, therefore, necessary for AI systems.



Enable the three entities to implement projects unitedly by concluding a tripartite MOU on top of two bilateral agreements

→ Share R&D information, jointly develop software, and promote shared use of facilities and other research resources

■ Participation in Technology Research Associations

AIST has become a member of Technology Research Associations, the members of which provide researchers, research funds, and equipment and carry out joint research and development of technologies used in industry. AIST contributes to the associations' projects from planning and performing research to utilizing research outcomes.

Particularly by providing our "members" and "places" to the associations, we aim to serve as a field where various people from different organizations can share their knowledge toward co-creation. We thus aim to help promote open innovation.

AIST "members" participate in the associations projects as researchers, project leaders or board members. We also provide our facilities as places to researchers from industries and universities participating in the associations for carrying out intensive research.

Participation in Technology Research Associations in FY 2017

- AIST participated in 19 associations.
- Intensive research projects were performed at AIST (11 associations marked with the letter "A" in the table).
- AIST researchers served as project leaders and managed the entire projects (6 associations marked with the letter "B" in the table).
- AIST managers served as directors (15 associations marked with the letter "C" in the table).
- AIST provided technical guidance and support, as well as know-how of equipment operation.

Technology Research Associations in which AIST participated (FY 2017)

1	Photovoltaic Power Generation Technology Research Association (PVTEC)	A		C
2	Lithium Ion Battery Technology and Evaluation Center (LIBTEC)	A		C
3	Fuel Cell Cutting-Edge Research Center Technology Research Association (FC-Cubic)	A		C
4	International Standard Innovation Technology Research Association (IS-INOTEK)			C
5	Photonics Electronics Technology Research Association (PETRA)	A		C
6	Chemical Materials Evaluation and Research Base (CEREBA)	A		C
7	Japan Advanced Printed Electronics Technology Research Association (JAPERA)	A		C
8	Technology Research Association for Next Generation Natural Products Chemistry	A	B	C
9	NMEMS Technology Research Organization Technology Research Association	A	B	C
10	Minimal Fab Development Association	A	B	C
11	Technology Research Association of Highly Efficient Gene Design (TRAHED)	A		
12	Technology Research Association of Magnetic Materials for High-Efficiency Motors (MagHEM)	A	B	C
13	International Research Institute for Nuclear Decommissioning (IRID)			C
14	Manufacturing Technology Research Association of Biologics (MAB)			
15	Thermal Management Materials and Technology Research Association (TherMAT)		B	C
16	Innovative Structural Materials Association (ISMA)			
17	The Research Association of Automotive Internal Combustion Engines (AICE)			
18	Technology Research Association for Future Additive Manufacturing (TRAFAM)		B	C
19	Geological Carbon Dioxide Storage Technology Research Association (CCS)			C

■ Deployment of Innovation Coordinators

AIST is strengthening its function of transferring technology to society by deploying 176 (as of June 2018) innovation coordinators responsible for liaising with external bodies such as companies and universities. In order to quickly and accurately understand diverse needs according to the characteristics of different industries, AIST assigns the innovation coordinators to various research domains and is also improving the organization of cross-sector marketing activities spanning different domains and regional research bases. As a result, the Research and Innovation Promotion Headquarters, research domains, and research units in AIST are working together to promote collaboration with partners.

These comprehensive, cross-sector marketing activities enhanced by the deployment of innovation coordinators are contributing to the creation of innovation through new business and connections between different fields.

Opportunities for Industry–Academia–Government Collaboration and Researcher Invitation

AIST supports R&D and product development of private companies by conducting joint research, commissioned research, and testing and calibration as well as by providing technology consulting, technical advices, and research materials. In addition, AIST explores potential applications of new technologies in collaboration with companies and universities—for example, through the operation of AIST Consortiums—with the aim of developing new markets.

Active invitation of external researchers

Acceptance of external researchers for joint research
Number of researchers accepted in FY 2017: 2,421

AIST provides researchers from our joint research partner institutions with an access to AIST's state-of-the-art facilities to conduct effective joint research.

Joint research program involving transfer of human resources
Number of researchers transferred to AIST under this program in FY 2017: 3

Under this joint research program, researchers from our joint research partner institutions are temporarily stationed at AIST. (The partner institution bears the cost equivalent to the amount of the personnel expenses in the form of research expenses.) Researchers from both our partner institutions and AIST can thus deepen their research collaboration and accelerate their R&D, taking full advantage of our research infrastructure and human resources.

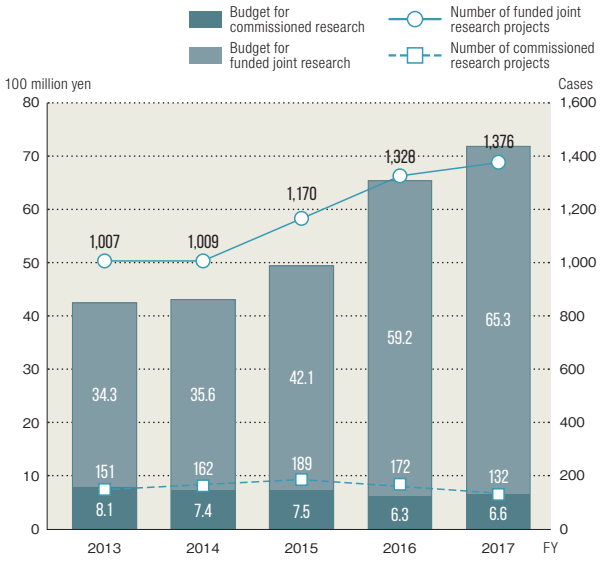
A platform for industry–academia–government collaboration

AIST recruits members from, and collaborates with, various companies and organizations to organize thematic research association (AIST Consortiums). We explore potential application of cutting-edge technologies and aim at promoting R&D and creating new markets.

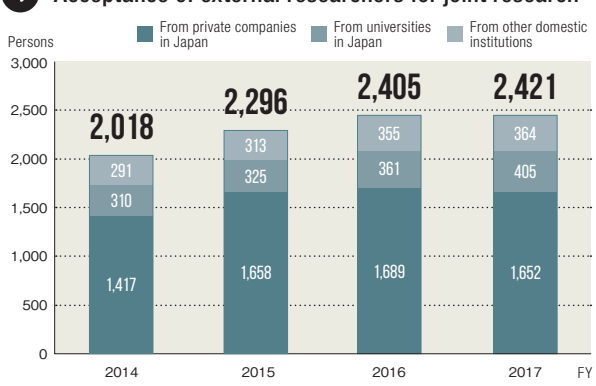
Joint and commissioned research projects conducted in past years

Our joint research is R&D projects between AIST and our cooperative partners—companies, universities, or public research institutions with common objectives and goals—with the aim of creating innovative results that cannot be achieved by individual research. Commissioned research is a type of R&D project conducted solely by AIST under contract with a company or other organization. Through this service, companies can use AIST's research potential to offset their lack of necessary technology to proceed with their own R&D project. Technology consulting is a system by which AIST—a multidisciplinary group of professionals—provides solutions based on its cutting-edge research capability and abundant knowledge to overcome challenges that companies cannot solve by themselves. In FY 2017, 411 cases were implemented.

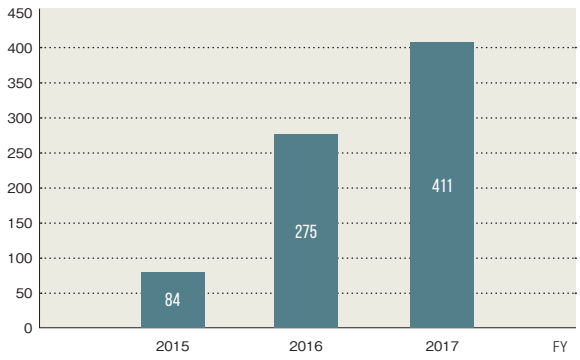
Joint and commissioned research with companies



Acceptance of external researchers for joint research



Number of technical consulting



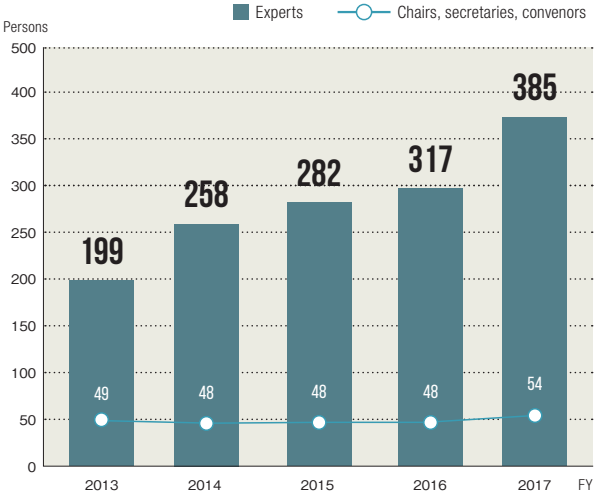
Promoting International Standardization

AIST promotes standardization activities, utilizing its R&D achievements. Our employees play key roles in international standard-setting bodies, most notably the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). In the committees of these bodies, 54 AIST employees are serving as chairs, secretaries, or convenors while 385 participating as experts.

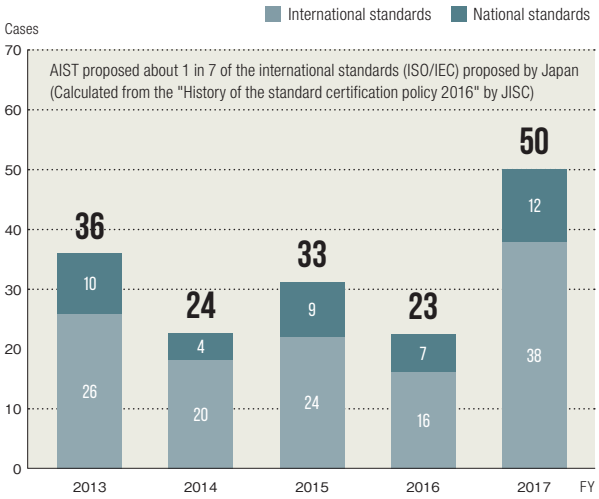
FY 2017 saw the issuance of the Japanese Industrial Standards (JIS) on the safety and performance requirements for personal care robots, and of ISO standards specifying methods for determining the biobased content of rubber and rubber products, among other standards. That year, AIST proposed a total of 50 domestic and international standards.

AIST has held the Symposium on Strategies for International Standardization each year since FY 2011, with the aim of enhancing standardization efforts by sharing the importance and challenges of standardization and certification with relevant parties in industry and government. In FY 2017, AIST cohosted this symposium with NEDO, taking the theme of "For Exit Strategies of 'Things to Come' with Connecting, Expanding, and Accelerating: Working toward a Society Based on Creating New Value by Utilizing Connected Industries, Internet of Things, and Artificial Intelligence."

Contribution of AIST staff to international standardization activities



Number of proposed standards



Increasing Global Presence

AIST has been increasing its global presence, not only by conducting world-leading research but also by enhancing cooperation, and exchanging personnel organization-wide, with overseas research institutes. In an effort to enhance such cooperation, AIST together with RIKEN organized the Sixth Global Summit of Research Institute Leaders in October 2017. The purpose of this summit is to provide those leaders with an opportunity to discuss face-to-face the future of science and technology, the roles of individual institutes, and collaboration among them. The sixth summit was attended by leaders representing 20 world-renowned research institutes of 12 countries, who engaged in vigorous discussion about how public research institutes should contribute to a sustainable society. As the representative of AIST, President Ryoji Chubachi made opening remarks, in which he emphasized the importance of this summit as an opportunity to facilitate international collaboration, referring to as an example the signing of a new MOU on comprehensive research collaboration with a participating institute that was made possible by networking through past summits.

The 6th Global Summit of Research Institute Leaders

Strengthening International Collaboration to Address Global Issues

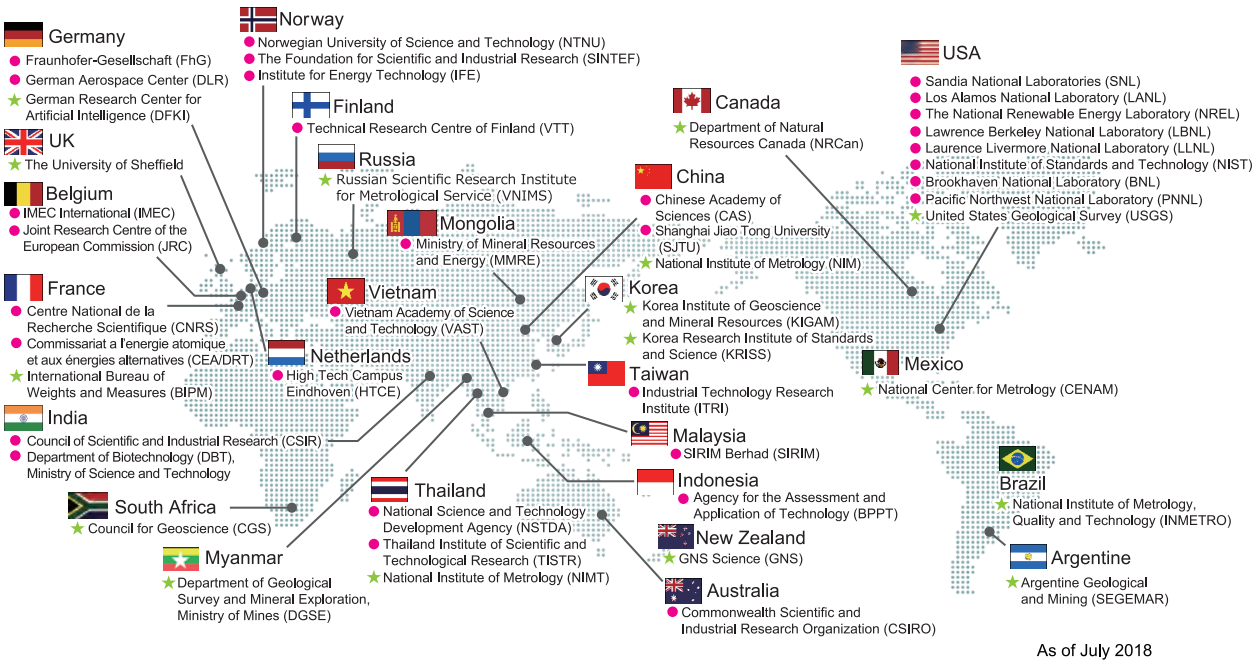
AIST has been building an international research network by concluding MOUs on comprehensive research collaboration with 31 research institutes worldwide. These MOUs have enabled us to conduct joint research and personnel exchanges with the partner institutes as we work toward addressing global issues. In May 2017, we held a signing ceremony of the MOU on comprehensive research collaboration with the European Commission's Joint Research Centre (JRC), which was followed by the visit of JRC Ddirector-Ggeneral and other key personnel to AIST Tsukuba in October 2017. AIST and JRC have been actively seeking ways to advance collaboration going forward, including personnel exchanges.

In October 2017, we held the sixth joint symposium with Taiwan's Industrial Technology Research Institute (ITRI). Since the 2005 conclusion of the MOU on comprehensive research collaboration, AIST and ITRI have successfully conducted joint research projects, especially in the energy and metrology fields. The sixth symposium was participated by researchers active in fields ranging from energy and the environment to materials, chemistry, electronics, manufacturing, and metrology, producing tangible outputs toward future cooperation in research and other areas.

Signing ceremony of MOU with JRC, European Commission (May, 2017)

List of MOUs

● : Comprehensive MOUs : 31
★ : Specific MOUs (excerpts) : 43



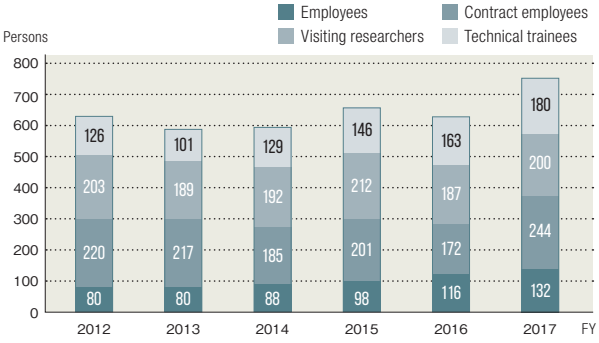
As of July 2018

Invitation to Foreign Researchers

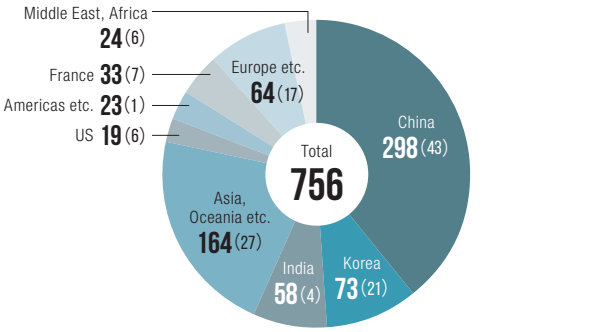
To enhance cooperation with overseas research institutions and to develop an international network of researchers, we actively accept researchers from universities and research institutions outside Japan. In FY 2017, a total of 756 foreign researchers engaged in research at AIST.

In terms of regional statistics, more than 70% were from Asia with those from Europe making up the second largest group. We will continue to develop close collaboration with overseas research institutions through personnel exchange.

Number of foreign researchers



Number of foreign researchers by country and region in FY 2017

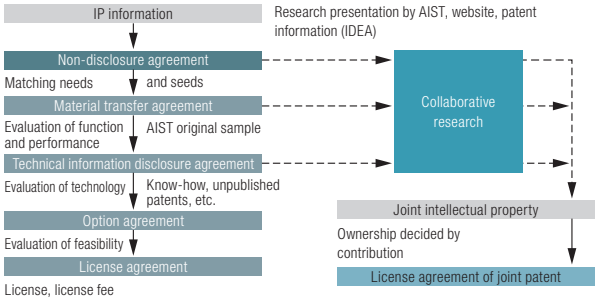


*Numbers in parentheses are those with employees status.

Technology Transfer Activities

It is AIST's mission to contribute to the development of the economy and industry by disseminating its research achievements in society. To achieve this mission, AIST develops a strategic approach to obtain intellectual property (IP) rights, and appropriately maintain and manage such IP rights so that the research achievements lead to technology transfer. In addition, AIST is strongly and powerfully promoting technology transfer centering on intellectual property.

Technology transfer process



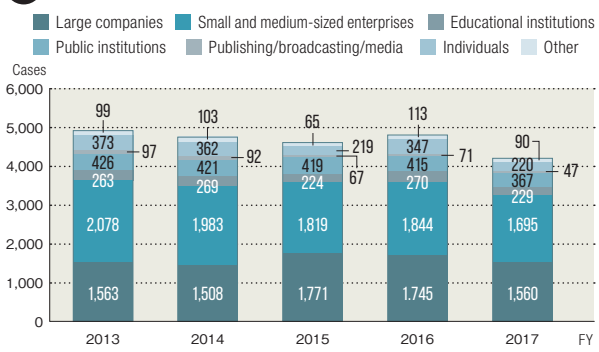
Technical Advice Service

AIST welcomes technical questions and requests of joint research not only from companies but also from academia, media, and other public research institutions. The general advice desk provides answers to the questions and requests by consulting appropriate scientists at AIST, such as technical advisers, innovation coordinators, and researchers.

Example of technical advice service

[Consultation request] A request to provide a technique to prevent chain abrasion
[Actions taken and answers given] Provided a technique to improve abrasion resistance by plating the shaft of the industrial chain and heat-treating the surface by lasers.

Number of technical consultations



Innovation School

AIST's Innovation School is working to broaden the horizons of young researchers and to raise their awareness using a specially developed curriculum. It aims to train them to be ready to contribute to innovation.

To address increasingly complicated social issues, we need to develop innovative technologies by combining the ideas and technologies of AIST and external organizations. For this we need personnel who can play a central role in collaboration. AIST actively accepts young researchers with PhDs, and master's and PhD students, and trains them so that they have scientific and technological knowledge in specific areas of expertise. They are given opportunities to develop communication and cooperation skills they need to work with experts in different fields from a broader perspective.

In FY 2017, we employed 17 postdoctoral researchers and conducted lectures, seminars, and long-term business training as part of the training course of human resources for innovation. To improve our education programs for graduate students, we ran a half-year course on basic research skills, and 28 students completed the program of lectures, seminars, and technical training. Moreover, we accepted 4 graduate students who were interested in the program as observers.

Curriculum of the Innovation School

1. Lectures and exercise at AIST
   - Lectures on philosophy and management and on the activities of researchers in industry, academia, and government and of corporate executives
   - Lectures and exercises on topics such as standardization and research, intellectual property and research, design thinking, risk assessment, and career development
   - Lectures on a research approach of integrating and configuring component technologies based on research scenarios
   - Exercise to improve skills in presenting research in ways that can be understood by people from different fields
   - Acquisition of business manners
2. Research at AIST
   - Working on research topics in laboratories
   - Experiencing research covering the process from basic research to product development in a seamless way
3. On-the-job training with companies (about 3 months on average, part of the training course of human resources for innovation)
   Students of the school are sent by AIST to companies to learn the following through experience:
   - Importance of the procedures used to conduct research, the speed of technology development, and cost awareness
   - Importance of teamwork and collaboration with other departments.

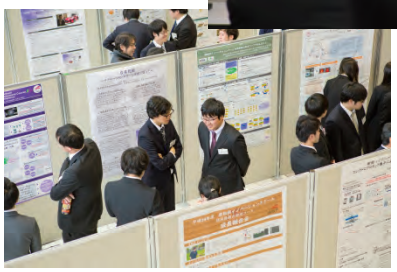
Expanding the vision and providing opportunities to young researchers

Students of the school say such things as "I found that the knowledge and the experience in my research is also applicable to companies," or "The communication skills learned in the school was helpful." They realize from experience that there are a variety of opportunities to work as researchers; to develop such insights as "The most important thing is the awareness that I work in an organization," or "You need to share a language with those with expertise in each area;" and to broaden their horizons. Companies that have accepted trainees say that "We gained valuable technological knowledge from the students," or "The students inspired those of our employees who were from the same generation." The companies rate the trainees' research capabilities and work attitudes highly.

Since the school started, 292 postdocs have completed the training course of human resources for innovation. They have discovered their new potential and are working in a variety of areas at companies, universities, and public research institutions.

At a lecture

A lecture by the president



Progress report presentation

AIST Research Assistant Program

To develop human resources with world-class, high-level expertise and practical research ability that produce results leading to innovation, AIST provides the AIST Research Assistant Program to hire graduate students with high levels of ability. This program allows talented graduate students to focus on research for their degrees without financial difficulties. By participating in AIST's R&D activities which meet social needs, students can develop the ability to plan and conduct the advanced research, which is crucial for R&D activities. In FY 2017, 266 graduate students in doctoral programs engaged in R&D at AIST.

Voices of research assistants

The best part of being an RA is that you can interact on a daily basis with researchers and students of different fields whom you would not meet at university. (Third-year student of doctoral program)

It is a very fortunate situation in which research abilities can be improved, and I would like many graduate students to participate. (First-year student of master's program)

Employment requirements for AIST Research Assistants (as of July 2018)

Candidate	Graduate students in master's programs	Graduate students in PhD programs
Requirements	R&D and paper-writing abilities that help promote of AIST's R&D projects, and independent execution of duties with staff guidance.	Superb R&D and paper-writing abilities that contribute highly to the promotion of AIST R&D projects, and independent execution of duties with staff guidance.
Days of employment	Avg. 4-14 days/month	Avg. 10-14 days/month
Salary	1,500 yen/hour (approx. 80,000 yen/month for 7 working days)	1,900 yen/hour (approx. 200,000 yen/month for 14 working days)
Number of employed graduate students in FY 2017	266	

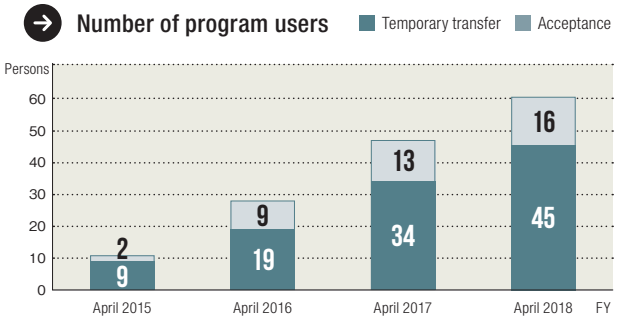
Cross-appointment Program

To create a cross-institutional research system, in November 2014 AIST established a cross-appointment program. This program allows a researcher to enter into employment contracts with two institutions and he/she can work as a regular researcher for each of them.

Interchange of researchers between AIST and the other institutions will increase mobility of human resources among academic, industrial, and governmental sectors. As a core institution for transfer of technology, AIST is expected to adopt superior technology seeds produced by fundamental research by universities and to promote transfer of technology for practical application of research outcomes and creation of new industries.

Today, we accept 45 researchers from 17 universities and 1 institution, and send 16 researchers to 8 universities and 2 institutions. (As of April 1, 2018).

Number of program users



TIA collaborative research program ("Kakehashi")

"Kakehashi" (a Japanese word for "linking bridge") is a program that promotes collaboration among the five organizations of TIA (AIST, National Institute for Materials Science, the University of Tsukuba, High Energy Accelerator Research Organization, and the University of Tokyo). Since it started in FY 2016, Kakehashi has been supporting projects with the aims of finding "seeds" and "sprouts" of research and technology at various stages, nurturing "buds" through collaboration and transferring "fruits" to industry.

Activities in FY 2017

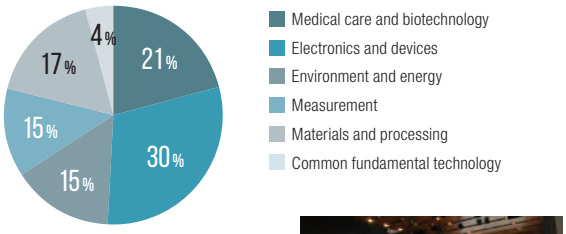
The fifty Kakehashi projects in FY 2017 cover biotechnology and computational materials science, as well as numerous fields covering interdisciplinary areas.

Ten collaborative groups and organizations were formed with Kakehashi as a start, and more than 100 workshops and symposia were held.

Second TIA "Kakehashi" Achievement Report Meeting

The second TIA Kakehashi Achievement Report Meeting was held on July 4, 2018, gathering corresponding researchers of all the 50 projects and about 220 participants. Results reported there included advancement in diagnosis and treatment of cancers using advanced glycan analysis technology.

Various fields studied under the Kakehashi program



The Second TIA Kakehashi Outcomes Report Meeting

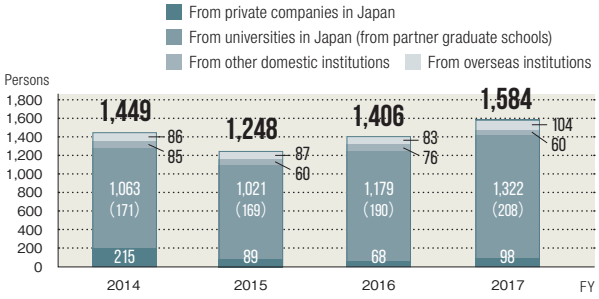
Technical Training

The technical training is a program in which AIST accepts researchers, engineers, and students from companies, universities, and public research organizations for defined periods and provides them with an opportunity to study technologies under the instruction of AIST researchers. The program may also be used for the purposes of short-term technical training (internships) and educational programs for academic credits, which are both designed mainly for university students. In FY 2017, 1584 trainees participated in this program.

Collaboration with partner graduate school programs

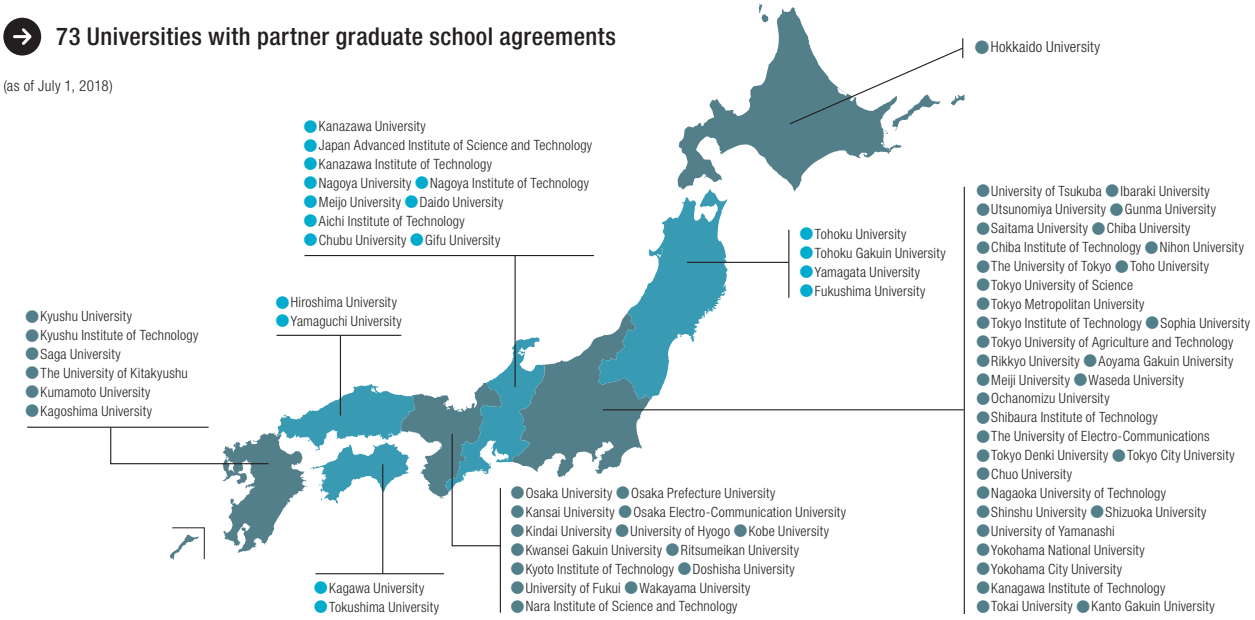
Using the knowledge and experience gained at AIST, AIST researchers teach as guest professors at graduate Technical Training schools that have cooperation agreements with AIST. AIST provides technical training to graduate students, and AIST researchers advise them on their research.

Number of trainees on technical training



73 Universities with partner graduate school agreements

(as of July 1, 2018)



03 Labor Practices

We aim to ensure global and local environmental conservation and the safety and health of all people at AIST.

Occupational Health and Safety

As would be expected in laboratories, AIST uses substances and equipment that may affect the human body and the environment, such as various chemical substances, high-pressure gases, radioactive materials, genetically modified organisms, nano-materials, laser equipment, and machine tools. Accordingly, AIST has an Environmental Safety Charter in place to create a work environment in which all people working here can do so in a safe and healthy manner. AIST is working to improve the health and safety of its employees as a top priority.

Safety and Health Committee meetings and site meetings of AIST bases

Safety and health managers hold Safety and Health Committee meetings, which are attended by labor and management representatives, at each AIST site and research base every month to discuss health and safety issues.

Representatives from each AIST department at the base discuss safety and health issues at the Safety and Health Committee meetings and at other site meetings. The results of the meetings are communicated to all employees through departmental meetings and the like.

Establishment of Safety and Health Guidelines

AIST's Safety and Health Guidelines set out a code of safety conduct, including precautions when handling hazardous chemicals and high-pressure gas cylinders and performing experiments, in accordance with our Environmental Safety Charter.

Serving as the basis for employee safety education and for laboratory work, these guidelines are reviewed and revised annually, in addition to amendments when needed. The FY 2017 revisions include: the addition of precautions related to managing toxic and dangerous substances in light of the amendment to the policy for managing hazardous chemicals and substances on AIST premises; the addition of precautions related to transporting waste liquid tanks with the aim of preventing persons transporting them from tripping; and the incorporation of the specified chemical substances that were newly designated by the amended Ordinance on Prevention of Hazards Due to Specified Chemical Substances.

Emergency preparedness

AIST conducts disaster, fire, and other security drills so that we can promptly respond to emergencies such as disasters and accidents, thereby minimizing damage.

To ensure a means of communication with our regional research bases nationwide in the event of a disaster, we also conduct emergency communication drills using emergency radiotelephones installed at those bases. In addition, our research bases take part in the Japan Meteorological Agency's earthquake early warning drills that use its Earthquake Early Warning system. When participating therein, we simultaneously perform safety confirmation drills in preparation for a major disaster, using our safety confirmation system.*

As part of preparedness for disasters such as earthquakes, we stockpile food, rescue equipment, and other emergency supplies, which are inspected and refreshed on a regular basis.

*In the event of a disaster, the safety confirmation system automatically sends bulk safety confirmation emails to employees. It automatically collects the results and displays them on the web.

A disaster drill

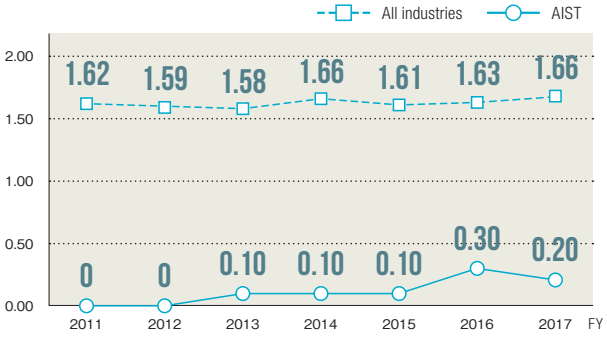
Preventing occupational accidents

In the event of a work-related accident, an investigation and analyses are conducted to determine the cause. The relevant work is put on hold until recurrence-prevention measures are implemented, and information on the accident is communicated to all employees to prevent similar accidents.

AIST holds a Safety Management Report Meeting every morning. At this meeting, AIST connects 13 research bases across the country through a teleconferencing system to exchange information on (1) accidents at the regional research bases, AIST Tsukuba, and other sites, and (2) near-miss incidents and health issues. The aim is to share details of recurrenceprevention measures and thus improve safety and health.

FY 2017 saw a year-on-year increase in the number of occupational accidents involving injuries or tripping. To address this situation, we provide safety education to make sure that proper protective equipment is worn, and due care and attention is maintained when working outside laboratories, among other matters.

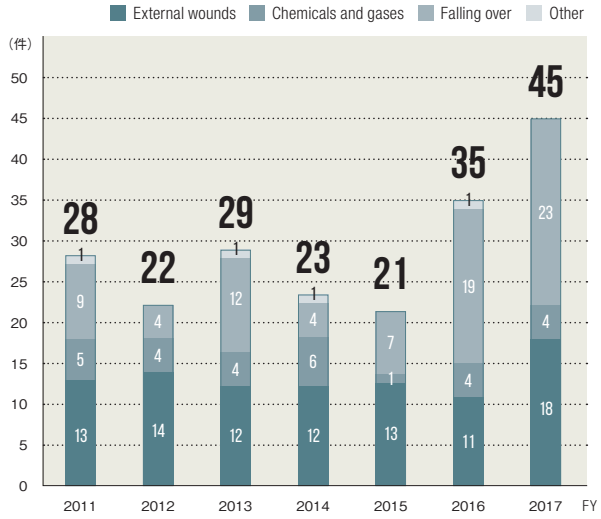
Incidence of accidents resulting in absences from work



- Incidence of accidents resulting in absences from work

Frequency of accidents expressed as the number of casualties from industrial accidents per million cumulative work hours. Incidence of accidents resulting in absence from work = number of casualties from industrial accidents /number of cumulative work hours 1,000,000

Trends in the number of occupational accidents



Safety education and support for license acquisition

AIST accepts many researchers, engineers and students from businesses, universities and the like for cooperative research, technical training and so forth. With a view to preventing accidents, AIST runs a number of safety training programs and classes, both for employees and for visitors from other organizations.

Safety education provided when employees are hired and when there is a change in work details is managed by an internal safety education management system, which allows participation history and program contents to be checked. To broaden learning opportunities, an e-learning system is used in parts of the safety training for life science experiments.

A program of education and training for animal experiments teaches participants how to design a suitable experimental plan and gives them the knowledge and attitudes needed to conduct experiments; it is based on the 3Rs stipulated by law, namely Replacement (i.e., use alternative methods), Reduction (reduce the number of animals used), and Refinement (reduce pain). AIST has made it compulsory for those responsible for hazardous chemicals in quantities exceeding a given amount to obtain a Hazardous Materials Engineer's License. In this way, we are committed to improving safety management in our laboratories. Also, we actively support employees in acquiring licenses. For example, we host a course on the skills required for a Health Officer's License and a course on the skills required for a Chief Technician's License for Using Organic Solvents.

Main education and training programs and workshops held in FY 2017

Program	No.of sessions	No.of participants
Course on skills required for a Health Officer's License	2	39
Course on skills required for a Chief Technician's License for Using Organic Solvents	2	48
Course on skills required for a Chief Technician's License for Using Specified Chemical Substances	1	32
High-pressure gas safety course (for those handling high-pressure gases for the first time)*	4	506
High-pressure gas safety course (for those handling high-pressure gases on an ongoing basis)*	4	882
General safety workshop (for all those responsible for hazardous chemicals, etc.)*	4	1897
Education and training for recombinant DNA experiments (e-learning participants)*	1	987
Education and training for animal experiments (e-learning participants)*	1	225
Education and training on human ethics in life science experiments (e-learning participants)*	1	78
Training on conflict of interest in medical research*	1	120
Education and training for biosafety	1	15
Education and training for those involved in animal experiments*	1	100
Course on safe driving*	16	2109
Joint radiation education and training (for radiation workers)*	3	329
X-ray education and training (for new users of X-ray equipment)*	92	301
Course on compliance with laws and regulations on radioactive materials (for managers)	1	57

★Taking training programs is mandatory for all related employees.

Hiring Fixed-Term Employees through Open Recruitment at AIST

The work conducted by AIST's headquarters and operational organizations includes routine work such as purchasing, asset management, and employee benefit management which can be done more effectively by engaging highly experienced employees.

A skilled contractor and a temporary employee who have been working at AIST for a certain period of time can be candidates for employment by AIST under the fixed-term regional employment system (i.e. employing administrative staff who are not transferred from one region to another). AIST has hired 40 people as personnel in total, and these employees have been working at the head office and in operational organizations. We receive dozens of applications each year, and in FY 2018, hired five persons.

The employees can work for up to 2 years, yet they have a chance to be hired under the indefinite-term employment system based on evaluations of their work performance. 28 employees have been rehired under the indefinite-term employment system so far.

AIST will continue to hire fixed-term regional employees to support research and development, innovation, and other activities.

Number of persons newly employed each year

FY	Number of persons employed
2013	5
2014	5
2015	7
2016	10
2017	6
2018	5

Support for Work–life Balance

Support for balancing work with childcare or nursing care

AIST strives to create a working environment conducive to balancing work with childcare or nursing care needs. The numbers of employees who used leave programs are shown on the next page.

In an endeavor to help employees with childcare, three of our research bases—AIST Tsukuba, Chubu, and Kansai—have temporal day care where employees can leave their children while at work. Moreover, employees visiting our research bases with no such facilities or major cities are able to use the private-sector, day-care centers or babysitters that we have contracted. The numbers of employees who used these facilities are shown on the next page.

Meanwhile, as part of initiatives to support nursing care, we held a work-life balance seminar, in which an outside expert lectured on how approaches to nursing care differ between men and women to consider nursing care methods from the perspective of personal relationships and gender. About 100 employees attended the seminar, many of whom took the seminar for their future needs. The seminar was followed by an explanatory session regarding AIST's childcare and nursing care systems.

Information on childcare and nursing care services is available on our intranet sites titled "Childcare Square" and "Nursing care Square," respectively, which supply information on the relevant programs.

AIST has both flextime and discretionary work systems in place to allow for flexible working arrangements. The flextime system is used by 30% of employees while the discretionary work system by 55% to balance work with life, regardless of whether they have childcare and nursing care.

Action Plan to Support the Development of Next-Generation Human Resources

AIST's Fourth Action Plan to Support the Development of Next-Generation Human Resources, effective from April 2017 through March 2020, is primarily aimed at enabling employees to return to work smoothly from maternity or childcare leave. Toward that end, we endeavor to offer pertinent information to the needs of individual employees. Initiatives undertaken in FY 2017 include an information meeting on maternity and childcare systems, and individual interviews with employees who returned from childcare leave. All of the 19 regular male and female employees who took maternity or childcare leave have returned to their work.

To familiarize employees with our childcare and nursing care support systems, we have prepared and are distributing leaflets that introduce respective systems. We also organized information meetings at AIST Tsukuba, Tohoku, and Chubu for childcare and nursing care programs in FY 2017. Furthermore, in 2017 we launched six lunch meetings, three on childcare and three on nursing care, at AIST Tsukuba. The lunch meetings provided employees with opportunities to gather and exchange information.

Teleworking program for childcare

Since FY 2016, we have offered a teleworking program, as part of initiatives that help researchers to minimize career interruptions for life event and play an active role in spite of working hour constraints, in accordance with our action plan under the Act on the

Promotion of Female Participation and Career Advancement in the Workplace. Employees may be allowed to work from home using IT equipment for the period approved by the president. The number of users of this program increased from 12 (two male and 10 female) employees in FY 2016, to 20 (five male and 15 female) employees in FY 2017.

The support program for researchers who have restriction on working hours due to childcare and nursing care

As a measure to support researchers who have restriction on working hours for childcare, nursing care, and other reasons, we have started to employ supplemental staff on a trial basis. During FY 2017, 12 researchers were supported (11 for childcare and one for prenatal support).

Introducing "Premium Friday"

On February 24, 2017, AIST introduced "Premium Friday," a government-led program that encourages employers to allow employees to clock off early on a Friday of each month. AIST employees have been advised to, on each Premium Friday, finish work by around 3 p.m. and leave the office early to the extent of not causing any problems for work. As a result, on Premium Fridays between February 2017 and January 2018, about 20% of employees left work either earlier than usual or on time without overtime. Accordingly, this program can be expected to bring benefits such as motivating employees to identify and adjust their working hours as well as encouraging them to clock off early and take paid leave. In view of that, AIST intends to continue with this program.

Numbers of people who used the various leave programs

	FY2014		FY2015		FY2016		FY2017	
	Male	Female	Male	Female	Male	Female	Male	Female
Leave to care for sick children	101	178	116	185	110	192	124	224
Special childcare leave	28	13	43	11	32	11	27	14
Extended childcare leave*	1	26	3	33	4	27	2	38
Nursing care leave	39	25	47	30	51	37	69	45
Extended nursing care leave*	0	0	0	2	1	0	2	4

*Number of employees starting the leave within the fiscal year

Numbers of employees who used child daycare services (totals)

	FY2014		FY2015		FY2016		FY2017	
	Permanent employees	Contract employees	Permanent employees	Contract employees	Permanent employees	Contract employees	Permanent employees	Contract employees
AIST Tsukuba	1,276	971	1,202	864	1,135	1,016	1,872	1,069
AIST Chubu	26	88	43	93	7	33	5	112
AIST Kansai	248	115	228	15	190	10	229	5
Private child daycare facilities and babysitters	32	0	13	0	7	1	32	26

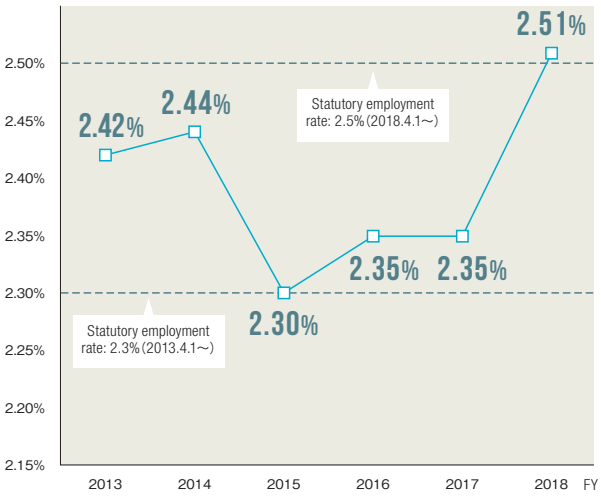
Efforts to Hire People with Disabilities

AIST actively hires people with disabilities. In April 2018, the statutory employment rate for people with disabilities was increased to 2.5%. We hired people with disabilities at every opportunity and achieved the statutory employment rate. (The disability employment rate as of June 1, 2018 was 2.51%.)

We create a work environment that helps the physically challenged work with ease and provides support for them in cooperation with each region's Support Center for People with Disabilities. Thus, we aim to increase the percentage of physically challenged people who are taken on as employees and remain at work. (This percentage was 87.5% in FY 2017.)

Change in employment rates for people with disabilities

(% of June 1 of each year)

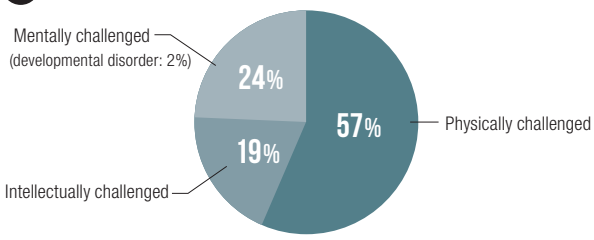


Percentages of people with disabilities remaining at work

FY	2012	2013	2014	2015	2016	2017
Number of people at the beginning of the fiscal year	80	88	86	91	87	88
Number of people who left AIST within the fiscal year	7	7	14	12	10	11
Employee turnover rate	8.75%	7.95%	16.28%	13.19%	11.49%	12.50%
Employee retention rate	91.25%	92.05%	83.72%	86.81%	88.51%	87.50%

Employment rates by disability type

As of June 1, 2018



Response to the Disability Discrimination Elimination Act

On April 1, 2016, the Act on the Promotion of Elimination of Discrimination against Persons with Disabilities (Disability Discrimination Elimination Act) was implemented. This law aims to create a tolerant and inclusive society in which everyone can live in peace without being discriminated against because of their disabilities.

In line with the law, AIST put in place a system to promote the elimination of discrimination against people with disabilities; we developed guidelines specifying what attitudes and actions employees should take in dealing with disability issues, and we established consultation services at research bases throughout Japan to provide advice to people with disabilities and those working with them. Moreover, to further deepen employees' knowledge and understanding of the law, we have continued to invite experts to hold study sessions and we have provided an e-learning system.

In addition, we actively carry out community outreach programs, which include holding meetings with commissioned welfare volunteers in neighboring areas to exchange information and introduce our initiatives, as well as hosting tours of our facilities for students with visual disabilities.

These initiatives have increased employee awareness and understanding to such a degree that individual employees are now making voluntary efforts to create a society in which persons with disabilities can live with peace of mind. For example, prior to holding an event, the expected participants are asked about their needs and wishes so that we can pay attention suitable for the characteristics of their disabilities; and the facilities on AIST premises used by visitors have been made barrier-free (such as tactile paving) based on employee suggestions.

By continuing to work on initiatives like these, AIST employees are expected to give consideration and assistance to persons with disabilities not only at day-to-day work but also in their personal lives.

A tour of our Geological Museum

A visitor facility rendered barrier-free

Activities of Intellectually or Developmentally Challenged Teams

AIST has set up Challenged Teams, made up of people with intellectual challenges and developmental challenges, at AIST Tsukuba, AIST Chubu and AIST Kansai. Each year, with reference to regional minimum wages, these people are employed on contracts at wages above the minimum wage for the region. They perform clerical support work, environment improvement work and the like with the support of instructors.

AIST Tsukuba

The AIST Tsukuba Challenged Team, made up of 12 members and four instructors, assists with clerical work and improves the working environment. Upon request from departments of AIST Tsukuba, the members carry documents between offices, shred discarded printouts, recycle binders, and do cleaning, among other tasks. When AIST Tsukuba holds an annual open house, they prepare for the event by putting leaflets into envelopes to hand them out to visitors and, on the day of the open house, present on the team's work and the members' hobbies, as well as giving away small reusable grocery

Preparing bags to be handed out at an open house

Making mini eco-friendly bags for an open house

bags made from disused geologic maps, and other items. These giveaways to visitors are so popular that they run out very quickly every single year.

AIST Chubu

The AIST Chubu Challenged Team currently has one member who joined in April 2018. The team's tasks include cleaning meeting rooms, rearranging furniture in preparation for events, collecting and sorting used paper and paper products, and beautifying the premises. The team is active in various other areas, such as helping bind copies of AIST Chubu's public relations magazine, which serves as its communication tool.

AIST Kansai

The AIST Kansai Challenged Team presently comprises two members, working primarily to beautify the premises. It contributes to maintaining trees and vegetation there by clearing weeds with a brush cutter, cutting high dead branches with a tree trimmer, and doing other tasks by hand or using various machinery and tools. When it rains, the members chiefly clean the windows, mop the floors, and shred discarded documents, in the buildings. In addition, upon request from departments of AIST Kansai, the members help out with various other tasks, such as rearranging furniture in meeting rooms and bringing disused items to a garbage dump.

Rearranging furniture and cleaning the venue for a physical checkup

Sorting used paper collected

Clearing weeds

Cutting branches with a tree trimmer

Health Management and Mental Health

General and special medical examinations are performed in spring and autumn every year. We strive to increase the percentage of employees who undergo medical examinations by raising awareness that they are required to take these examinations, including health screening. As follow-up care after medical examinations, an industrial physician and industrial health staff provide health advice. We provide support to improve the performance of individual employees and AIST as a whole by detecting and preventing employees' health disorders and illnesses in their early stages.

To address mental health issues, we have developed a unified Mental Fitness Program in accordance with the directives and guidelines of the Ministry of Health, Labor, and Welfare. Four programs based on the Mental Fitness Program are implemented in a continuous and planned way. They focus on (1) self-care; (2) line care through implementation of education and training and seminars; (3) care by in-house industrial health staff and others through face-to-face counseling with an industrial physician and industrial health staff and support in returning to work; and (4) care by external resources through the use of external mental health organizations.

From FY 2016 we have introduced a stress check system (once a year) to encourage awareness of stress situations of staff and to promote workplace improvement to create a comfortable workplace. By doing this, we are making efforts to strengthen measures to prevent staff from suffering mental health disorder.

Numbers and percentages of permanent and contract employees who underwent periodic medical examinations (including health screening), 2013–2017

Top: percentage of examinees.
Bottom: no. of examinees/ total no. of eligible employees

FY	2013	2014	2015	2016	2017
(1) Employees (excluding (2)) *1	99.9%	99.9%	99.6%	99.7%	99.8%
	2,990／2,993	2,965／2,966	2,978／2,989	3,022／3,031	3,061／3,067
(2) Contract employees *2	99.9%	100%	100%	99.9%	99.8%
	2,136／2,139	2,252／2,252	2,150／2,150	2,319／2,322	2,436／2,440

★1 Excluding those on extended childcare leave and sick leave and those on long leave due to overseas relocation ★2 Social insurance policyholders only

Numbers of permanent and contract employees (including temporary employees) who underwent special medical examinations in FY 2016–2017

Top: no. of examinees/ total no. of applicable employees in spring.
Bottom: no. of examinees/ total no. of applicable employees in autumn

FY		2016			2017		
Special medical examination		Permanent employee	Contract employee	Total	Permanent employee	Contract employee	Total
Medical examination for organic solvent poisoning prevention	Spring	761／761	631／631	1,392／1,392	758／758	581／581	1,339／1,339
	Autumn	759／759	682／682	1,441／1,441	759／759	614／614	1,373／1,373
Medical examination for specified-chemical poisoning	Spring	446／446	323／323	769／769	459／459	303／303	762／762
	Autumn	444／444	352／352	796／796	466／466	326／326	792／792
Medical examination for ionizing radiation exposure	Spring	326／326	80／80	406／406	313／313	92／92	405／405
	Autumn	320／320	83／83	403／403	325／325	91／91	416／416
Medical examination for lead poisoning	Spring	10／10	8／8	18／18	13／13	7／7	20／20
	Autumn	11／11	7／7	18／18	14／14	7／7	21／21
Medical examination for laser injury	Spring	270／270	106／106	376／376	272／272	117／117	389／389
	Autumn	42／42	12／12	54／54	43／43	20／20	63／63
Medical examination for pneumoconiosis	Spring	9／9	15／15	24／24	11／11	19／19	30／30
	Autumn	4／4	2／2	6／6	0／0	2／2	2／2
Medical examination for asbestos exposure	Spring	6／6	2／2	8／8	5／5	1／1	6／6
	Autumn	6／6	2／2	8／8	5／5	2／2	7／7

Numbers of employees with significant findings* from AIST's medical examinations, and numbers of employees who received face-to-face counseling

①Number of employees with significant findings, and their percentages of the total

FY		2013
With significant findings (Rated C)	No. of employees	785
	Percentage of employees	15.3%
With significant findings (Rated D)	No. of employees	483
	Percentage of employees	9.4%

FY	2014	2015	2016	2017
With significant findings (D-diagnosed)	423	103	117	134
	8.1%	2.8%	2.5%	2.2%
With significant findings (E-diagnosed)	598	818	970	907
	11.5%	21.0%	20.5%	14.6%

✶ ENumbers of C- and D-rated persons cover the period 2011–2013. Numbers of D- and E-diagnosed persons cover FY 2014-2015

②Numbers of employees who received counseling, and their percentages to employees with significant findings

FY		2013
With significant findings (Rated C)	No. of employees who received counseling	712
	Percentage of employees who received counseling	90.7%
With significant findings (Rated D)	No. of employees who received counseling	470
	Percentage of employees who received counseling	97.3%

FY	2014	2015	2016	2017
With significant findings (D-diagnosed)	350	71	98	110
	82.7%	68.9%	83.8%	82.0%
With significant findings (E-diagnosed)	569	801	862	791
	95.2%	97.9%	88.9%	87.2%

Definition of criteria:
● Before FY 2013 A: within normal range; B: follow-up examination required; C: detailed examination required; D: treatment required
● After FY 2014 A: no anomalies; B: mild abnormalities but no interference with daily life; C: follow-up examination required; D: health advice required; E: treatment required; F: counseling required (applicable only to special medical examinations)

Number of face-to-face health consultations (FY 2017)

Cases

FY		Tsukuba	Hokkaido	Tohoku	Chubu	Kansai	Shikoku	Chugoku	Kyushu	Tokyo	Tokyo Waterfront	Fukushima
Industrial physician	Body	888	103	38	132	135	57	17	5	34	33	9
	Mental	334	3	13	61	75	13	0	10	1	28	2
Industrial health staff		1,523	654	46	351	441	77	28	6	78	134	18
Total		2,745	760	97	544	651	147	45	21	113	195	29

Flu shots (at AIST)

Persons

FY	2013	2014	2015	2016	2017
AIST Tsukuba/Tokyo	1,782	1,837	1,912	1,927	1876
Regional research bases	532	555	543	538	664
Grand total	2,314	2,392	2,455	2,465	2,540

Other activities

Persons

FY	2013	2014	2015	2016	2017
Refreshing exercise	291	304	243	219	246
Walking lessons	—	—	—	—	377
Emergency first-aid workshop	145	175	188	154	80
Mental health seminars	93	64	73	133	79
Workshop (training)	252	162	180	407	187

04 Fair Operating Practices

Aiming at an organization that is trusted by society, we conduct our activities with sincerity

Management of Conflict-of-Interest

Promoting industry-academia-government collaborations and disseminating research achievements are AIST's key missions. However, there may be cases in which our executive or employee has personal interest in a partner organization in one of those collaborations. In that event, their personal interest derived from the collaboration may frequently conflict with their duties and research responsibilities as an executive or employee of AIST, a public research institute, with the result that a conflict of interest arises. In view of that, AIST has set rules and guidelines governing conflict-of-interest management to properly control these conflicts. In doing so, we aim to create an environment in which our executives and employees can advance industry-academia-government collaborations with no worry and to live up to the trust society places in us.

Our executives and employees are asked to declare their own status of conflict-of-interest every fiscal year. In FY 2017, all the personnel subject to this rule (3,322 people) submitted these declarations. Of these, four personnel were deemed at risk of conflicts of interest owing to their active involvement in industry-academia-government collaborations, and were interviewed by outside conflict-of-interest counselors to look into their activities. Additionally, the four personnel plus those who declared their conflict-of-interest status were provided with advice and guidance on how to promote industry-academia-government collaborations going forward.

When conducting medical research involving human subjects, conflicts of interest must be managed in compliance with Ethical Guidelines for Medical and Health Research Involving Human Subjects, in particular to protect subjects and enhance research transparency.

Accordingly, when executives and employees intend to conduct medical research that is subject to these guidelines, they are required to make applications and then undergo examination by the Conflict-of-Interest Management Committee for Clinical Research, whose members include outside experts. The committee examined four applications in FY 2017.

Information Security

AIST provides information security training to all users of our information network on a continuous basis, so that they can improve their understanding of the information security policy of AIST. This enables appropriate use of the network with awareness of responsibility. In addition, we confirm the degree of understanding and permeation of our policy among the users through regular self-inspections for personal information protection and information security as well as information security audits.

Information security training

AIST requires all the executives and staff to take information security training every year, to implement and improve information security awareness. The content of the training is reviewed every year and the newest measures on information security are presented.

Self-inspections for personal information protection and information security

We implement self-inspections of executives and staff to see whether appropriate measures are taken for information security in accordance with our security policy. Almost all of our eligible staff conducted self-inspections in FY 2017.

Information security audit

AIST conducts information security audits within the institute to objectively evaluate whether information and the information security system are properly used, managed, and operated. In FY 2017, in order to enhance the information security of AIST as a whole, we conducted information security audits of 70 units.

Unauthorized access to AIST information systems

We detected unauthorized access to our systems from the internet on February 6, 2018, and shut down our internet access and our intranet business systems to prevent further damage. Then we promptly analyzed the extent of damage, route of intrusion, and other details, and restored our systems. We have compiled a report on this incident and information security countermeasures to be taken. The report is disclosed on our website (in Japanese).

URL
https://www.aist.go.jp/aist_j/news/announce/au20180720.html

Implementation of Security Export Control

The security export control is an important effort in maintaining peace and security in the international community. In Japan, in addition to the regulations on weapons trade itself, the export of goods and transfer of technologies that may be used for the development and manufacture of weapons are regulated according to the "Foreign Exchange and Foreign Trade Act" to prevent the proliferation of weapons of mass destruction and excessive accumulation of conventional weapons. Therefore, companies and institutions that may develop relationships with overseas companies and institutions must have tight export control.

In FY 2004, AIST formulated Rules for the Security Export Control and gave notification of them under the title "Internal Compliance Program" to the Ministry of Economy, Trade and Industry. In accordance with these rules, we have tight security export controls in place.

Security Export Control activities include: (1) communicating the latest information on export control within AIST; (2) export control training for AIST staff; (3) export control instruction to individual staff members; (4) classification and transaction screening; and (5) conducting internal audits.

In recent years, as collaborative research with overseas research institutes and universities is promoted, there has been an increase in the importance of raising awareness of security export control among employees. Accordingly, security export control is in place as mentioned above, and individual employees are now fully aware of security export control.

AIST will continue to promote further implementation of security export control in the future to maintain peace and safety as a member of the international community.

Training in export control within AIST

Promoting Rational Procurement

Each year, we formulate and announce AIST Rational Procurement Policy, in compliance with the May 25, 2015 decision of the Minister for Internal Affairs and Communications on the promotion of measures to rationalize incorporated administrative agencies' procurement. Our policy aims to streamline procurement operations autonomously on an ongoing basis while ensuring fairness and transparency, using a plan-do-check-act cycle in light of the characteristics of our duties and operations. To that end, it details the measures we take to establish internal controls and prevent misconduct relating to negotiated contracts, and specifies the indicators appropriate to assessing these measures. To ensure the implementation of this policy, we have set up a Contract Oversight Committee, whose members include outside experts, to have individual contracts inspected ex post. The summarized proceedings of the committee's meetings are also disclosed.

Once a fiscal year ends, we conduct a self-assessment of how our rational procurement policy for the fiscal year has been implemented, using the set indicators. The results are publicized and reported to the competent minister.

Expediting Procurement Process by Introducing Special No-bid Contract Method

On June 28, 2016, the Cabinet adopted its basic policy on the promotion of R&D at designated national research and development agencies (which was partially amended on March 10, 2017). AIST was the first such agency that complied with this basic policy and introduced a new negotiated contract method (special no-bid contract method). The features of the new method are twofold: it applies exclusively to a purchase of goods and services directly related to R&D that amounts to five million yen or less; and, in lieu of widely used general competitive bidding, the new method in principle relies on open competition based on estimates, under which public notice periods are shorter than those for general competitive bidding. We began operating the new method on October 1, 2017, and concluded 891 contracts thereunder during FY 2017.

The introduction of the special no-bid contract method has enabled us to shorten the period between issuing a request for proposal and signing the contract, approximately from 40 days to 20 days. This was accomplished while ensuring the transparency and competitiveness of procurement, contributing to achieving higher-quality R&D results faster.

Implementing Market Testing

In accordance with the Basic Policies on Public Service Reform adopted by the Cabinet on July 15, 2011, AIST Tsukuba combined eight services relating to its facility management into one procurement contract, which was implemented for three years from FY 2012 to 2014.

From FY 2015 onward, to make procurement even more competitive, this one contract covering eight services was divided into the following five contracts from the perspective of optimization: (1) maintenance and management of AIST Tsukuba facilities, (2) management of trees and vegetation on AIST Tsukuba premises, (3) safeguarding and cleaning of AIST Tsukuba buildings, (4) operation and management of the Research Collaboration Center, the Science Square Tsukuba, and the Geological Museum, and (5) driving, maintenance, and management of AIST Tsukuba vehicles. These contracts were implemented for three years through FY 2017.

By optimizing these services through division into five contracts, a number of benefits have been obtained in terms of service quality, the primary ones for FY 2017 being listed on the right.

Maintenance and improvement of the quality of services

- Understanding each other's work (holding work report meetings)
- Ensuring safety
- Ensuring continuity of work
- Being environmentally friendly
- Ensuring a comfortable facility environment

Average satisfaction rates in a questionnaire survey of facility users:

• Operation and management of the Research Collaboration Center (Sakura Kan)	97% (recommended minimum approval rate 90%)
• Operation and management of the Research Collaboration Center (Keyaki Kan)	99% (recommended minimum approval rate 90%)
• Operation and management of Science Square Tsukuba	97% (recommended minimum approval rate 90%)
• Operation and management of the Geological Museum	99% (recommended minimum approval rate 90%)

Green Procurement, Priority Procurement from Sheltered Work Centers, Etc.

Green procurement and other initiatives

When AIST purchases products, parts, and materials needed for R&D or outsources processing and prototype manufacturing, among other tasks, consideration is given not only to the quality and prices of goods and services but also to their environmental impact. In this way, we advance green procurement (contract) that gives priority to goods and services that have less impact on the environment. To promote this practice, each year AIST discloses its policy for promoting the procurement of eco-friendly goods and services,*1 in accordance with the Act on Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities (Green Purchasing Act), and the government's Basic Policy for Promotion of Procurement of Eco-friendly Goods and Services.

Pursuant to the Act on Promotion of Government's Procurement of Goods Supplied by Facilities for Persons with Disabilities to Work, every year AIST also discloses its policy for promoting the procurement of goods from those facilities and its procurement results.*2 Furthermore, AIST has introduced a procurement method that evaluates suppliers based on how they promote work-life balance, with the aim of realizing public procurement contributing to women's active participation in the workforce.

*1: For more information, please visit our website.
https//www.aist. go.jp/aist_j/procure/kouhoyou/green/

*2: For more information, please visit our website.
https://www.aist.go.jp/aist_j/procure/kouhoyou/syuroshisetsu/

Status of procurement of eco-friendly goods

In FY 2017, AIST purchased 274 items in 21 categories among the 235 items in 20 categories designated in the Green Purchasing Act (types of eco-friendly goods and services to be preferentially purchased by the government and other organizations). Excluding one item (media storage cases) because of their required functions and performance, AIST achieved 100% procurement rate for each designated procurement item (i.e. those that met the criteria established by the government for items that reduce environmental loads). The environmental loads are

Purchase results of major designated procurement items

Area	Item		Target	Total quantity purchased	Purchase of specified purchase items	Target attainment
Paper	Photocopier paper		100%	28431.58 kg	28431.58 kg	100%
	Forms		100%	544.8 kg	544.8 kg	100%
	Coated paper for inkjet color printers		100%	1050.6 kg	1050.6 kg	100%
	Toilet rolls		100%	3949.8 kg	3949.8 kg	100%
	Tissue paper		100%	12414.9 kg	12414.9 kg	100%
Stationery	Mechanical pencils		100%	872	872	100%
	Mechanical pencil leads		100%	428	428	100%
	Ballpoint pens		100%	13591	13591	100%
	Marker pens		100%	18253	18253	100%
	Media cases		100%	1210	920	76%
	Glue (including glue sticks and glue pouches)		100%	2597	2597	100%
	Adhesive tape		100%	815	815	100%
	Files		100%	118315	118315	100%
Office furniture, etc.	Chairs		100%	1555	1555	100%
	Desks		100%	902	902	100%
Copying devices	Photocopiers, etc. *3	Purchased	100%	28	28	100%
		Leased/rented (new)		8	8	
		Leased/rented (extension)		243	243	
	Scanners	Purchased	100%	172	172	100%
		Leased/rented (new)		0	0	
		Leased/rented (extension)		0	0	
Office equipment	Paper shredders	Purchased	100%	107	107	100%
		Leased/rented (new)		0	0	
		Leased/rented (extension)		0	0	
	Recording media		100%	7741	7741	100%
	Toner cartridges		100%	7718	7718	100%
	Ink cartridge		100%	5768	5768	100%
Vehicles, etc.	Non-general official vehicles	Purchased	100%	5	5	100%
		Leased/rented (new)		5	5	
		Leased/rented (extension)		5	5	
Fire extinguishers	Fire extinguishers		100%	42	42	100%
Services	Passenger transportation		100%	1526	1526	100%

*3: Photocopiers, combination units, digital photocopiers with expandable functions

also considered in purchasing eco-friendly products (such as trash bags) that are not designated procurement items.

Number of hybrid vehicles owned by AIST

As of April 2018, of the 61 AIST-owned vehicles for business (including research), 7 are hybrid vehicles, 1 is a plug-in hybrid vehicle, and 4 are electric vehicles. In replacing the automobiles, preference will be given to hybrid and low-emission vehicles.

Green Contract Activities

When signing contracts with contractors and suppliers, AIST promotes a green contract that takes into consideration reduction of greenhouse gases on the basis of the "Act on Promotion of Contracts of National Governments and Other Entities Involving Due Care for Reduction of Greenhouse Gas Emission (Green Contract Act)." In FY 2017, we signed the following green contracts.

For automobile purchases, we evaluated the price and environmental performance (fuel economy) of 8 vehicles for lease in a comprehensive evaluation bidding system in which the bidder with the highest rating entered into the contracts.

For contracts for power supply, we adopted the environmental threshold system at AIST Tsukuba Central and East, AIST Tsukuba West, AIST Tsukuba North, AIST Hokkaido, Fukushima Renewable Energy Institute, AIST Tokyo Waterfront, AIST Kansai, AIST Chugoku, and AIST Shikoku.

The system was also adopted for 17 industrial waste contracts for collection, transport, and disposal.

- Environmental threshold system

This is a bidding system with screening by the sum of score points of carbon dioxide emission coefficient, unutilized energy usage, new energy usage, and planned amount of green power certificate to be transferred to the purchaser. The bidder that has a certain total score that surpasses the threshold and presents the lowest price has the right to enter into the contract.

Number of green contracts

Type of green contract	Number of cases
Automobile purchase	8
Contract for power supply	9
Industrial waste	17

05 Community Involvement

Building a trusting relationship with the community, including awareness of being a member of society

Geological Museum

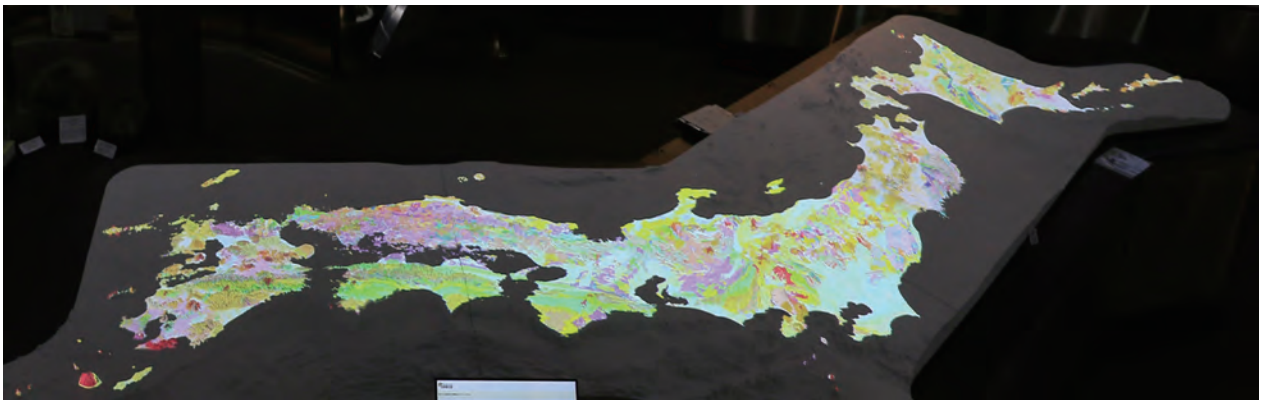
Our Geological Museum, which specializes in geoscience and exhibits the findings of the research activities of the Geological Survey of Japan, AIST, is a unique facility among those in the world. In addition to showcasing numerous specimens of minerals, rocks and fossils, the museum displays what geology is and how it is important for us to know about it in a comprehensive and easy-to-understand manner. It welcomed 46,787 visitors in FY 2017, achieving a cumulative total of 1.2 million visitors in May 2018.

In March 2018, the exhibition of the three-dimensional geologic map of the Japanese archipelago was upgraded to project geological and other information onto a detailed three-dimensional terrain model introducing a projection mapping technique. Operating a touch-panel device, visitors can project different information such as the location of active volcanoes and transportation networks on a background image of a topographic map, a geologic map or others, and visually learn how closely the landscapes relate to our daily lives. Each year, the museum hosts several special exhibitions, hands-on events, and lectures. It has also launched the kids' pages on its website in April 2017, which have been well received ever since.

- Closed on Mondays except for national holidays (closed on the next weekday instead), and from December 28 to January 4
- Opening hours: 9:30 a.m. to 4:30 p.m.
- Enquiries to the Geological Museum
  TEL: +81-29-861-3750 FAX: +81-29-861-3746 www.gsj.jp/Muse/en/

Children observe sand under a microscope in the hand-on event "Beautiful World of Sand."

The Geological Museum disseminates geological information to society.



The exhibition of the three-dimensional geologic map of the Japanese archipelago boasts world-class scale and resolution.

Hosting Open Houses (FY 2018)

Our research bases across Japan hold open houses every year, to increase community understanding and awareness of what AIST researches and how our research contributes to society. These events offer a variety of programs that include interest-piquing experiments, scientific craft classes, and tours of research facilities not open to the public on other occasions. For example, the AIST Tsukuba open house in FY 2018 featured programs enjoyable and educational for both adults and children, including collecting stamps on stamp cards and a special lecture, both related to the International System of Units (SI) whose redefinitions are scheduled to be adopted in the fall of 2018. Although one research base had to cancel its FY 2018 open house from the effect of damage caused by torrential rain in western Japan, nine open houses welcomed a total of 12,802 visitors nationwide.

Visitor feedback

- This was my first visit to AIST. It was worthwhile because I was able to learn the variety of research projects being conducted here and how they contribute to our lives.
- I had a lot of fun learning units through collecting stamps.
- I'm glad to come to this event, as it increased my awareness of everyday life in one way or another. I look forward to the next year's open house, too.
- This event taught me things I've never thought about. I want to come here again.
- I realize this for the first time at 56 years of age—what I've envisioned throughout my life since I was a kid has existed here in its entirety. I hope research, development, and progress will continue forever.

Petting amphibians

Silicon sponge making

Participating in External Scientific Events

At external scientific events for the general public, too, we exhibit booths in which participants conduct scientific experiments or practice scientific crafts. We are doing this because we want people to know AIST better and experience the fun of science. For instance, the Tsukuba Science Festival held by Tsukuba City in fall is an annual event participated by educational and research institutions (photo on the upper left). At the Science Festa in Akihabara, every day a different Tsukuba-based research institute participates as an opportunity to let people in Tokyo know about their organization (photo on the upper right). When invited, we participate in regional events as well. We exhibited a booth at the Hayabusa Matsuri festival, held at a space-related science center in Kakuda City, Miyagi Prefecture (photo on the bottom left). In addition, when a national science competition for junior high school students entitled "Science Koshien Junior" was held in Tsukuba in 2017, we exhibited a booth at the specially set-up venue (photo on the bottom right).

06 Human Rights

We create an environment where all those related to AIST treat each other with respect.

Respect for Basic Human Rights

A wide variety of people work at AIST, including executives, permanent employees, contract employees, temporary employees, visiting researchers, technical trainees, contractors, visitors participating in industry–academia–government collaborative programs, and visitors participating in international collaborative programs. We work with the awareness that it is important to have an attitude of respect for each other, regardless of title or position.

From the "Compliance Guideline"

Paragraph 1: Respect for human rights
– We respect human rights. We do not say or act in any way that ignores human rights.

1. We respect basic human rights. We do not discriminate against people on the basis of race, nationality, age, sex, religion, belief, or social status.
2. We do not say or act in any way that ignores human rights, including by harassment.

Protecting Human Rights in Research

AIST conducts research involving human subjects, which are categorized into ergonomic research and medical research. The latter is carried out in compliance with our Ethical Guidelines for Medical and Health Research Involving Human Subjects. Medical research at AIST consists of applied biomedical engineering experiments and experiments with human derivative samples.

In FY 2017, we implemented 47 new and 145 ongoing research projects involving ergonomic experiments; 41 new and 71 ongoing research projects involving experiments with human derivative samples; and four new and three ongoing research projects involving applied biomedical engineering experiments.

Prior to conducting an ergonomic experiment, the experimental protocol is reviewed by the Committee on Ergonomic Experiments, which includes six external members, in accordance with the Declaration of Helsinki* to ensure the safety and scientific validity of the experiment. Likewise, a medical research experiment is reviewed in accordance with ethical guidelines mentioned above, by either the Committee for the Ethics on the Applied Biomedical Engineering and Technology or the Committee for the Ethics on the Experiments with Human Derivative Samples, which include 13 and 12 external members, respectively. In addition, we have the Conflict-of-Interest Management Committee for Clinical Research in place, which was set up in FY 2016 to examine solely conflicts of interest in medical research. This committee reviewed four cases in FY 2017.

When an experiment is performed, its participants are given thorough oral and written explanations of the details of the experiment and of their right to revoke consent. In this way, we ensure that their human rights and dignity are protected.

*Subtitled "Ethical Principles for Medical Research Involving Human Subjects," this is a code of conduct adopted by the 18th World Medical Association General Assembly in Helsinki. Medical researchers have established this rule to regulate themselves with regard to medical research involving human subjects.

Harassment Prevention

Harassment hurts the dignity of the person being harassed and causes emotional distress and disadvantage. Conversely, if a person who conducted an act of harassment with no intention to do so is held responsible for that act, he or she may suffer from adverse health effects. The presence of harassment may lead to deterioration in the work environment, reduced motivation to work, and adverse effects on the results of research. AIST has internal rules in place and provides training to make the workplace free of harassment.

Harassment prevention measures

- AIST has in place rules for handling workplace harassment and sexual harassment and has defined procedures for the prevention of harassment.
- AIST provides counselors placed at AIST work sites with training on how to prevent harassment and provide counseling for harassment victims. We also held a seminar targeting all employees to re-recognize the need to prevent harassment.

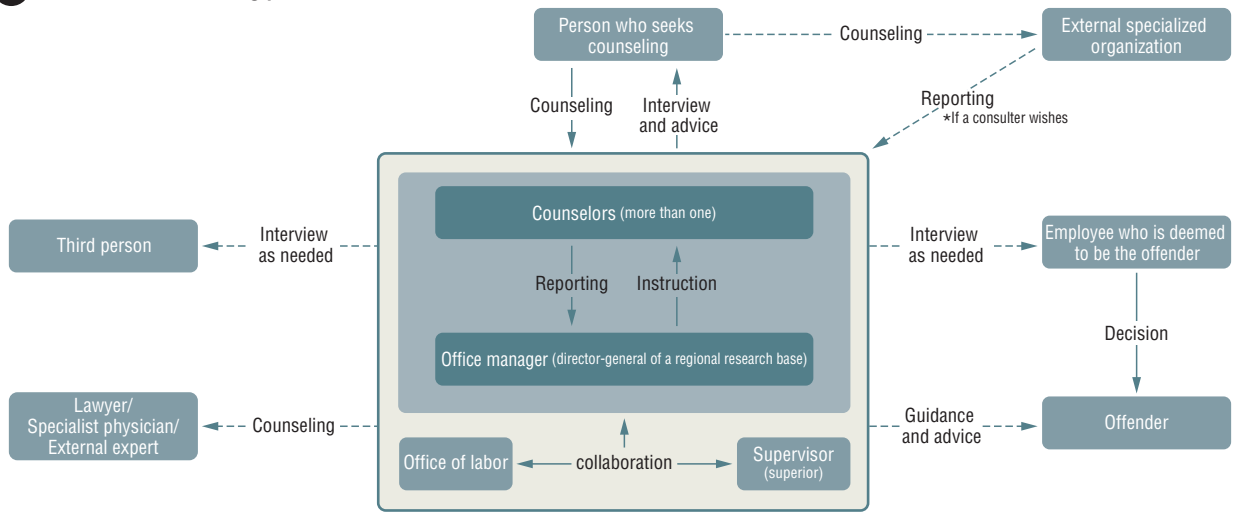
Counseling system

Each site has workplace harassment counselors. The counselors work to counsel, investigate, and mediate so that harassment victims are not distressed and suffer alone as a result of their experience. If the line of management or a counselor cannot address a harassment issue, a higher-level committee reviews the issue and recommends the appropriate actions, which are then taken. In addition, we create an environment that helps harassment victims to seek counseling. We also provide email and telephone counseling by industrial physicians or external organizations to protect people's privacy.

Training programs provided on harassment in FY 2017

Training program	Trainees	Objectives	Number of trainees in FY 2017
New Employee Training	New AIST employees	As part of training in the attitudes, basic knowledge, and skills required to perform their work, participants learn the basics of harassment issues and harassment prevention.	122
e-learning training for employees	Permanent employees, contract employees	As part of their learning of the basic organizational ethics and rules of AIST, participants learn the basics of harassment issues and harassment prevention.	4,366
e-learning training (English)	Foreign researchers and contract employees who have difficulty in understanding Japanese	Same contents as e-learning training (in English)	116
Harassment Counselor and Sexual Harassment Counselor Training	Harassment counselors, sexual harassment counselors, and counselors for pregnancy, childcare, eldercare harassment	Participants learn the harassment prevention knowledge and skills required by counselors. These include face-to-face counseling techniques based on lectures and role-play sessions.	36
Harassment Prevention Seminar	AIST employees who wish to attend the seminar	Participants learn the basics of harassment issues and harassment prevention through lectures and work.	124

Flow of the counseling process



*Those who seek counseling can include people other than the employees involved (i.e. they can be the employee who is deemed to be the offender, the employee who is deemed to be the victim, or someone else, such as a colleague or supervisor). *Counseling can be sought by means of a face-to-face meeting, telephone call, email, letter, or fax.(contact by email or telephone with external specialized organizations) *Seeking counseling causes no disadvantage. *Adequate consideration is given to the protection of privacy, and any information acquired in the course of counseling is kept strictly confidential.

Raising Awareness and Taking Steps to Promote Diversity

Utilizing a diverse workforce is essential to pursuing creative research and building vibrant workplaces. To provide a working environment that embraces the values and ideas of employees with various backgrounds, whether gender, age, or nationality, AIST formulated in October 2015 its Measures to Promote Diversity in the Fourth Medium- to Long-Term Target Period. To achieve these measures, we have devised and taken various steps under five action plans concerning: (1) proactively hiring female researchers and making the most of their abilities, (2) supporting foreign researchers in their recruitment and work, (3) achieving work-life balance, (4) developing careers, and (5) comprehensively promoting diversity.

AIST has set the goal of at least 18% of researchers it hires being female during the fourth medium- to long-term target period (FY 2015 to 2019), which is higher than the 16.7% achieved for the third target period (FY 2010 to 2014). The figure as of the end of FY 2017 was 17.6%. To increase the percentage of female researchers hired by AIST, we are working to attract more applicants, by assisting students with career exploration, holding a round table talk of female science students and AIST's female researchers, and organizing laboratory tours. Through these and other means, we strive to discover talented students and hire them proactively. During FY 2017, events for female students were held at AIST Tsukuba and Chubu. They were attended by 58 university students nationwide, some of whom were inspired by these events and are now engaged in research at AIST. We have also set the goal of at least 5% of our managers being female by the end of the fourth target period, aiming to foster the next generation of female managers. The figure as of the end of FY 2017 was 4.9%.

To instill and raise diversity awareness, we proactively hold seminars and training for employees. Newly hired employees and group leaders learn about diversity promotion as part of their training, with a view to building a better understanding about diversity among all employees, both male and female. Moreover, in FY 2017 AIST Tsukuba provided a training program encouraging career advancement for their personnel interested. Employees are also encouraged to take external career-development training offered by various providers, as a means of supporting their career advancement.

As a managing institution of the Diversity Support Office, a consortium of Japanese research and educational institutions aimed at enhancing cooperation and promoting diversity even more strongly, AIST organizes information exchange meetings, among other duties. Also, AIST, in partnership with the University of Tsukuba and IBM Japan, was selected by MEXT as a collaboration-type program under its Fiscal 2016 Initiative for Realizing Diversity in the Research Environment. Supported by this initiative that subsidizes projects designed to develop human resources in science and technology, AIST, together with the two partner organizations, continues working to further advance our action plan under the Act on the Promotion of Female Participation and Career Advancement in the Workplace. AIST was awarded a Grade 3 (the highest grade) Eruboshi certification by the government in September 2016 in accordance with the above-mentioned Act, and annually discloses information on women's participation in our activities. We will continue to drive diversity through various measures.

Introduction to AIST at a "round table talk with female researchers"

The Eruboshi logo:certification mark Level 3

Supporting Foreign Researchers

To build a working environment friendly to non-Japanese researchers, AIST provides work support and information in English.

The AIST International Center (AIC) provides foreign researchers with guidance, consultation, and assistance in English, among other services, to help them live and work in Japan. The service most frequently requested from foreign researchers is to act as their proxy in filing applications with the Mito Branch Office of the Tokyo Regional Immigration Bureau. In FY 2017, acting as proxy for foreign researchers, AIC filed 144 applications for extension of period of stay and others, which accounted for more than half of all the applications it filed.

AIC also offers Japanese language classes at AIST to help foreign researchers acclimate quickly to living in Japan. In FY 2017, a total of 48 foreigners took these classes. Foreign researchers having a busy schedule find it highly convenient to be able to take Japanese language lessons at AIST. Additionally, flower arrangement and tea ceremony classes are provided for foreign researchers and their family members.

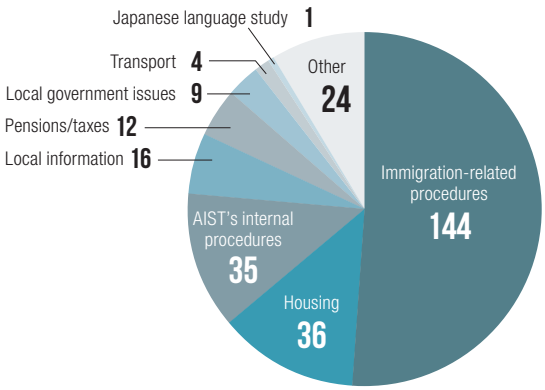
To help foreign researchers work to their best, we hold AIC seminars in which internal rules and programs are explained to foreign researchers in English, collaborating with relevant departments. In FY 2017, we held two such seminars: one was to explain AIST's foreign researcher invitation and other programs, and the other for offering Japanese language training to foreign researchers. These seminars were attended by a total of 48 persons, most of whom gave positive feedback while some requested for seminars to be held on other internal programs.

As a means of information provision, AIC Newsletter has been electronically distributed, almost monthly, since October 2015. The number of subscribers has exceeded 100. Having issued 27 times by the end of FY 2017, the newsletter provides a variety of information in English in a timely manner, covering such topics as timetables for helping file applications for extension of period of stay, upcoming AIC events, after-event reports, and links to webpages detailing AIST programs. In FY 2017, meetings were also held to explain the procedures for the intake of foreign workers, at our research bases in the Tokyo Waterfront, Chubu, and Fukushima areas.

On the AIST English website, we have added a section that offers information helpful to those living or staying around AIST Tsukuba so that visitors from outside Japan and foreign researchers working at AIST can quickly obtain useful information. We also work to enhance the English pages on AIST's intranet, by monitoring its content and sharing information with relevant departments. For foreign researchers whose Japanese proficiency is not yet sufficient, we offer e-learning courses in English to familiarize them with AIST's organization, ethics, and rules.

Together with relevant departments, we provide integrated assistance, ranging from support for living and working in Japan to language help.

Breakdown of consultations in FY 2017



Closing ceremony of the Japanese language course

The flower arrangement course

AIC seminar

07 Environmental Report

Creating an environment of mutual respect for everyone involved with AIST

Environmental Policy

To build a sustainable society, AIST has a Charter of Environment and Safety in place. Its aim is to bring the results of research and development to society, as well as to incorporate environmental considerations into the research and development process. Under the Charter of Environment and Safety, we have set an Environment and Safety Policy to proactively work with a keen awareness of the importance of ensuring global and local environmental conservation, and the health and safety of everyone working at AIST. This is done keeping in mind AIST's characteristic as a research institute that handles a wide variety of chemicals and poisonous substances.

Charter of Environment and Safety

- We promote research that helps to conserve the global environment and human safety; we aim to realize a safe, secure, and high-quality life and a society in harmony with the environment.
- We comply with laws and regulations on environment and safety, set our own standards such as guidelines, and seek to increase efforts for environmental protection and promotion of health and safety on a daily basis.
- We actively disseminate information on environment and safety and seek to achieve harmony and integration with local communities. We take prompt and appropriate actions in the event of an accident or disaster and seek to pass on the lessons learned to society under the principle of disclosure.

Environment and Safety Policy

1. We proactively conduct research that contributes to conservation of the environment and the development of a healthy and safe society.
2. We comply with laws, regulations, ordinances, and agreements on the environment, health and safety, set our own management standards, and seek to further improve environmental conservation, health and safety.
3. We seek to reduce the consumption of energy and resources and the generation of waste, and thus aim to reduce loads on the environment.
4. We seek to prevent pollution and work-related accidents, to take prompt and appropriate actions in the event of an emergency, and to prevent the spread of damage.
5. We are developing a management system for effectively and efficiently conducting activities to ensure environmental conservation, health and safety with the participation of all members of AIST; we seek continuous improvement.
6. We actively disclose environmental, health and safety information by publishing environmental reports and disclosing information to promote communication with society.

Environmental Compliance

We aim to promote AIST's compliance with laws and regulations, social norms, internal codes of conduct for researchers, and internal rules, and to realize AIST's motto, "in society, for society".

We take the following environmental protection actions to help protect the global environment and create a sustainable society.

1. We comply with international environmental regulations and regulations of the national and local government, and we work to prevent pollution and conserve the natural environment.
2. We promote research that helps to protect the global environment and human safety, and we proactively work to improve energy efficiency, conserve natural resources, and recycle resources.

Topics: Replacing Air Conditioning Equipment with Consideration for the Environment

AIST has been working to reduce designated fluorocarbons by upgrading ageing air conditioning equipment from equipment that uses HCFCs (hydrochlorofluorocarbons), which are designated fluorocarbons, to equipment that uses HFCs (hydrofluorocarbons), which are substitutes for designated fluorocarbons. In addition, AIST is working to control HFC leakages in accordance with the Act on Rational Use and Proper Management of Fluorocarbons (enacted April 2015).

In addition, in order to save energy and reduce CO_2 emissions, we are replacing gas-powered hot/cold water generators with energy-efficient, electric, air-cooled modular chillers and the like. At the same time, we are reviewing laboratory specifications and replacing special-purpose air conditioners required for precise temperature and humidity control with ordinary air conditioners (package air conditioners).

We estimate that these air conditioner replacements will result in an average energy saving of 30% in the 1105 affected rooms.

Air conditioner upgrades in FY 2017

Site	Rooms with upgraded air conditioning	Energy consumption (GJ/year)		Expected energy saving
		Before upgrade	After upgrade (predicted)	
Tsukuba Central	628	63,433	35,675	43.8%
Tsukuba West	96	3,393	3,000	11.6%
Tsukuba East	39	1,629	1,342	17.6%
Tsukuba North Site	32	2,101	1,378	34.4%
AIST Tokyo Waterfront (main building)	116	1,646	994	39.6%
AIST Chubu	124	28,937	22,829	21.1%
AIST Kansai	70	6,057	4,225	30.2%
Total	1,105	107,195	69,442	35.2%

Tsukuba Central 3 heating equipment:
Upgraded from gas-powered hot/cold water generators (top) to electric air-cooled modular chillers (bottom).
The upgrade is expected to provide an energy saving of 54%.

Environmental Targets and Results

Major environmental targets and results are summarized below. Details of the content and results for each item are available on the relevant pages.

Environmental Targets and Results

Legend: ◎ exceeded the target; ○ achieved the target; △ almost achieved the target; × missed the target

CO_2 emissions (details on p. 55)	
Target:	Reduce by average of 4% compared with FY 2014 over three years from 2017 to 2019 (target value: 119,000 t-CO_2)
Result:	109,000 t-CO_2 in FY 2017 (◎)

Promotion of green procurement (details on p. 42)	
Target:	100% procurement rate for designated procurement items
Result:	100% procurement rate for designated procurement items (○)

Promotion of green contracts (details on p. 43)	
Target:	Sign an exemption contract for power supply and industrial waste disposal in principle
Result:	Signed an exemption contract for power supply and industrial waste disposal in principle (○)

Overview of Environmental Burdens

AIST assesses the environmental burdens generated by its activities so as to reduce these burdens and pay due care to the environmental effects of its activities. The tables below show the amounts of energy used and waste released through AIST's activities.

Amounts of energy used and waste released by AIST's activities

( ): FY 2016 results

INPUTS

Energy 2,223TJ (2,209TJ)

Electricity	206,251 MWh (204,164 MWh)
Renewable energy (generated at AIST)	2,140 MWh (2,144 MWh)
City gas	4,563 thousand m^3 (4,602 thousand m^3)
Propane gas	1,400 kg (7,711 kg)
Liquid fuel	30 kL (81 kL)
Purchased energy	18 TJ (2,120 TJ)

Resources

Clean water	968 thousand m^3 (881 thousand m^3)
Groundwater	16 thousand m^3 (19 thousand m^3)

REUSED/RECYCLED

Recycled water	1,032 thousand m^3 (1,172 thousand m^3)
Equipment, materials, etc. (reused at AIST)	572 cases (584 cases)

OUTPUTS

Atmospheric emissions

Greenhouse gases	109 thousand t-CO_2 (112 thousand t-CO_2)
NOx	2.69 t (3.70t)
SOx	0.02 t (0.75t)

Waste

Specially managed industrial waste	399 t (362t)
Industrial waste	1,305 t (1,803t)
Non-industrial waste	567 t (515t)

Aquatic emissions

Sewerage discharges	872 thousand m^3 (873 thousand m^3)
Public waters	19 thousand m^3 (18 thousand m^3)

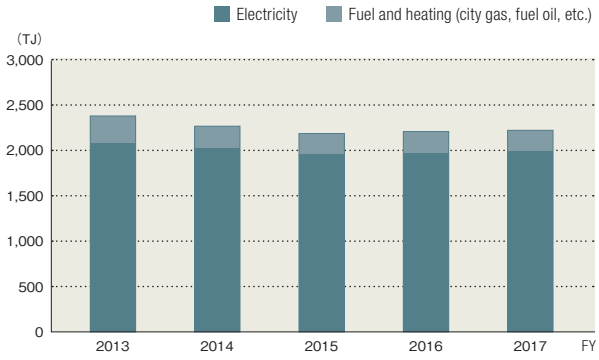
Water quality

BOD	1,095 kg (704 kg)	Nitrogen	770 kg (275 kg)
COD	806 kg (714 kg)	Phosphorus	53 kg (10 kg)
Suspended substances	555 kg (505 kg)		

Rationalization of Energy Use

AIST, as a specified business stipulated by the Act on Rationalizing Energy Use, promotes the rationalization of energy use. Although the amount of energy used in FY 2017 was 0.6% higher than in the previous year, the five-year rolling average of base unit energy consumption was 97.8%, below the benchmark of 99% given in the act. In business evaluations by class published by the Agency for Natural Resources and Energy (Ministry of Economy, Trade and Industry), AIST is recognized as an organization with good energy efficiency. We will continue to strive for energy savings.

Changes in amounts of energy used



Management Structure

AIST's headquarters organizations (Environment and Safety Headquarters and General Affairs Headquarters) and operating units (regional research bases and sites) work together closely to implement our environmental policies and environmental initiatives covering the whole of AIST.

The Environment and Safety Headquarters determines policy for the reduction of greenhouse gas emissions—an ongoing issue—and the General Affairs Headquarters develops and monitors AIST's green procurement policy.

These policies are embodied in the implementation plans of each regional research base and site under the leadership of the Director-General.

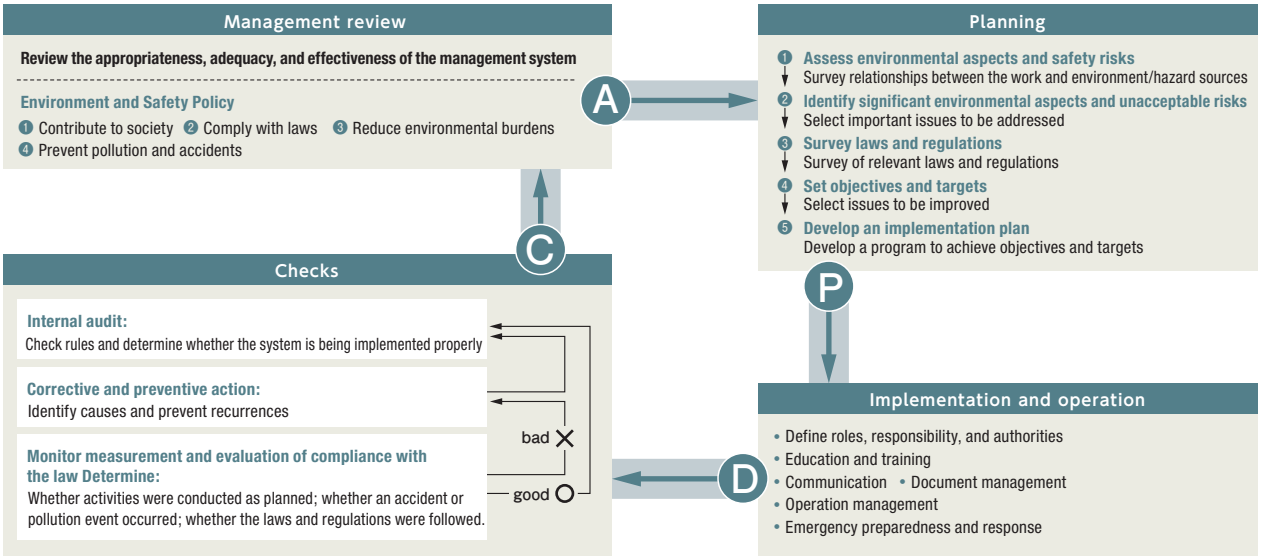
Structure for environment and safety projects

Environmental and Safety Management System

AIST has its own environmental and safety management system (ESMS) in place. It combines two subsystems: an environmental management system to reduce the environmental impacts of its activity and preserve the natural environment and an occupational health and safety management system to reduce potential risks in the workplace and improve health and safety.

In FY 2017, we conducted an internal audit of the environment and safety at each research base and site, and we checked implementation of the environmental and safety management program.

Structure of AIST's environmental and safety management system



Column: The role and future prospects of the Research Laboratory for IDEA

In April 2017, the Research Laboratory for Inventory Database for Environmental Analysis (IDEA) was opened at AIST's Research Institute of Science for Safety and Sustainability. IDEA provides comprehensive inventory data on products and services as the basis for life cycle assessment (LCA). The laboratory is continuously developing IDEA, promoting international collaboration, and developing new assessment procedures.

LCA is a method for quantifying the environmental effects of products, technologies, commercial enterprises, and organizations; LCA environmental assessment techniques have been standardized by the ISO. Quantitative arguments will be essential for making societies sustainable in the future in light of targets such as the SDGs and the Paris Agreement. LCA has also become important in recent years for evaluating the environmental impacts of business activities in fields such as ESG (environmental, social and governance) investment. The use of LCA is likely to continue growing rapidly across industries.

When the environmental effects of products, technologies, commercial activities, and organizations are to be externally publicized, international acceptance of the inventory data that is used for the calculation will become important. The purpose of IDEA is not just to provide data within Japan but to be compatible with foreign data formats and be usable with foreign software, and thus improve the international recognition of the inventory data. To promote international collaboration on inventory databases, the laboratory participates in technical discussions through the "Global LCA Data Access network" initiative administered by the UN Environment Programme and contributes to international cooperation. We further aim to develop Asian inventory database versions based on IDEA, provide technical assistance for database-development in other countries in Asia, and expand the use of inventory databases in Asia.

By providing assistance to businesses and R&D facilities, the laboratory is actively promoting LCA of new materials and new technologies as well as of technologies currently being used and products now being sold. The laboratory is supporting further development and commercialization of new materials and technologies backed by quantified scientific evidence of their environmental performance. We further developed the "IDEA matrix" which is a database that adds actual production amounts to IDEA and can be used to analyze relationships of material flows of Japan. The IDEA matrix will be used to assess the industrial, social and economic changes caused by new materials and technologies. Procedures and techniques to evaluate new materials will be established by conducting a series of case studies.

Actions against Global Warming

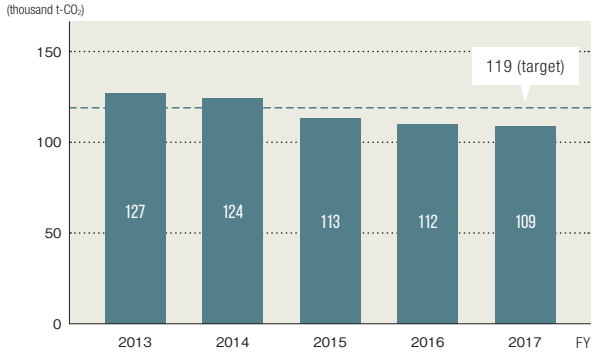
AIST has set a target and an implementation plan for reducing greenhouse gas emissions as part of the effort to reduce environmental burden substances generated by our operations. In FY 2017, AIST promoted research facility integration to achieve the target in the Fourth Medium- to Long-Term Plan of reducing greenhouse gas emissions from the FY 2014 level by 4% averaged over the three years FY 2017 to FY 2019. As a result, AIST achieved an 11.9% reduction in greenhouse gas emissions compared with FY 2014.

In December 2016, in response to a plan for government measures to reduce greenhouse gas emissions*1 approved by the Cabinet in May 2016, the Ministry of Economy, Trade and Industry adopted a plan for specific measures.*2 The ministry's plan sets a target of reducing total greenhouse gas emissions by 40% from the FY 2013 level by FY 2030, with a medium-term target of a 10% reduction by FY 2020. AIST is working on a medium- to long-term energy efficiency plan to achieve these targets.

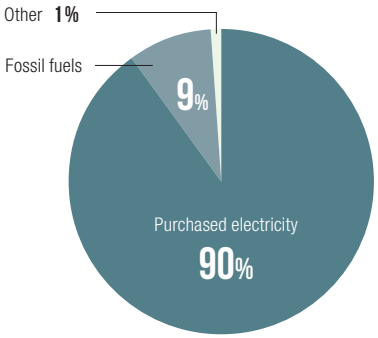
*1: Full title, "Plan specifying measures to be taken by the government to reduce greenhouse gas emissions associated with the government's administrative operations and activities" (cabinet decision, May 13, 2016)

*2: Full title, "Plan specifying measures to be taken by the Ministry of Economy, Trade and Industry to reduce greenhouse gas emissions associated with the Ministry's administrative operations and activities"

Changes in CO_2 emissions by year



Breakdown of sources of CO_2 emissions

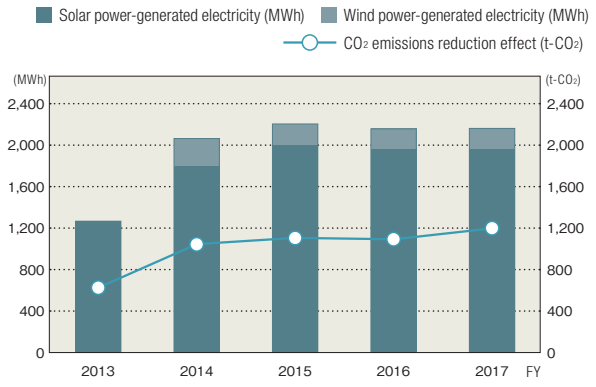


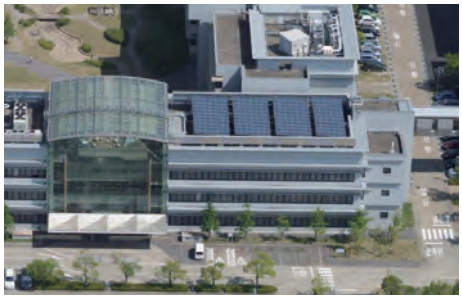
Reducing CO_2 Emissions by Using Renewable Energy

AIST has installed solar power generation facilities at AIST Tsukuba and also at AIST Tohoku, AIST Fukushima, AIST Tokyo Waterfront, AIST Chubu, AIST Kansai, AIST Chugoku, and AIST Kyushu. Our existing solar power systems are being used effectively, and solar and other renewable energy systems have been installed in our new buildings.

The amount of solar power generated in FY 2017 was 1936 MWh. This is equivalent to the annual power use of 538 households and helped reduce CO_2 emissions by 772 t/year. Wind power generation by AIST was 204 MWh and helped reduce CO_2 emissions by 107 t/year. In total, AIST generated 2140 MWh of renewable energy. This is equivalent to about 1.0% of total electricity consumption.

Progress in renewable energy generation and CO_2 emissions reduction





The solar power generation system at AIST Chubu

Environmental Education

AIST provides environmental education on issues with significant environmental impacts—such as how to treat liquid wastes and vent gases from research and how to sort and remove waste—to new employees and those who have joined AIST under the industry-academia government exchange program, the international exchange program, and dispatched workers. We are continuing to enhance our environmental education and training.

Appropriate Management of Chemical Substances

As AIST conducts research, it uses a wide variety of chemicals, usually in small quantities. Chemicals are properly used and stored to prevent fume releases, fires and leaks, and are properly treated for disposal.

Treatment of liquid waste and effluent gases after the use of chemicals

Liquid waste:

At AIST Tsukuba, inorganic liquid waste is rendered harmless in the treatment facility on the premises and is then discharged into the public sewerage system. AIST Tsukuba has outsourced the disposal of all organic liquid waste to an industrial waste treatment service provider since 2013. Regional research bases outsource the disposal of their organic and inorganic liquid wastes to industrial waste disposal service providers.

Effluent gases:

Toxic vapor-producing chemicals are used in fume hoods, and the toxic vapors are discharged through effluent gas treatment systems. Through the integrated chemical management system described below, AIST provides each researcher with information on the chemicals that may be used only in a fume hood and must be rendered harmless before being discharged.

Chemical Substances Integrated Management System

The wide variety of chemicals used in research are registered in the Chemical Substances Integrated Management System at times of delivery. Via AIST's intranet, the Chemical Substances Integrated Management System allows all employees to view information on the laws and regulations applicable to the chemicals being used and information on the properties and handling of each chemical (safety data sheets*). For Fire Service Law hazardous materials and high-pressure gases that have regulated storage amounts, the stored amount for each room is compiled and can be quickly viewed. The system is also used to collect information on chemicals that are subject to the Pollution Release and Transfer Register (PRTR) Act as shown below and to send reports to government agencies.

*Safety data sheet: a document that provides information on the risks, toxicity, physicochemical properties, handling precautions, restrictions and so forth, of chemicals.

Collecting Information on Released Chemical Substances

AIST reports on releases and transfers of chemicals subject to the PRTR Act (see "PRTR system"* below) and applicable municipal ordinances. At AIST, the following chemicals are used in large quantities: organic solvents to dissolve or extract various organic compounds; hydrogen fluoride to clean semiconductors; and ferric chloride to treat hydrogen fluoride liquid waste. The use of these chemicals must be reported every year.

Amounts of chemicals reported under the Chemical Control Program

Releases and transfers of chemicals subject to the PRTR Act (chemicals used in quantities of more than 1 ton)

Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Tsukuba Central 5	Hexane (kg)	1,500	580	0	920
	Dichloromethane (kg)	1,600	200	0	1,400
AIST Tsukuba West	Hydrogen fluoride and aqueous salts thereof (kg)	3,300	0	310	380
	Ferric chloride (kg)	70,000	0	0	2

Updated reports on releases and transfers of chemicals subject to the PRTR Act (chemicals used in quantities of more than 1 ton)

Values of releases and transfers in FY 2012, FY 2013 and FY 2015 that were partially missing but have now been determined have been updated and reported.

Research site	Substance	Details of change	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Tsukuba West, FY 2012	Hydrogen fluoride and aqueous salts thereof* (kg)	Waste amount set to zero	0	270	690 → 0
	N,N-dimethyl acetamide (kg)	Addition to reported amount	0	0	32
AIST Tsukuba West, FY 2013	Hydrogen fluoride and aqueous salts thereof* (kg)	Waste amount set to zero	0	240	670 → 0
	N,N-dimethyl acetamide (kg)	Addition to reported amount	0	0	4,500
AIST Tsukuba West, FY 2015	N,N-dimethyl acetamide (kg)	Addition to reported amount	0	0	3,600

*:The reported amount of hydrogen fluoride and aqueous salts thereof is set to zero because, after waste processing, waste material (sludge) of hydrogen fluoride and its salts used in semiconductor fabrication changes to a substance other than those on the list of substances that must be reported.

Tokyo Metropolitan Government: Releases and transfers of chemicals subject to ordinances relating to the health and safety of citizens and the environment (chemicals used in quantities of more than 100 kg)

Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Tokyo Waterfront (Bio-IT integrated technology facility)	Chloroform (kg)	120	13	0	110
	Ethyl acetate (kg)	140	15	0	120
	Methanol (kg)	300	21	0	280

Osaka Prefectural Government: Subject to ordinances relating to preserving the living environment of Osaka Prefecture (chemicals used in quantities of more than 1 ton)

Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Kansai	VOC (kg)	2,600	140	0	2,500

＊ PRTR system

The official name of the PRTR Act is "The Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof." Facilities that use any of the 462 designated type 1 chemicals in quantities of more than 1 ton per year (more than 0.5 tons in the case of some chemicals) must report the amount released to the environment and the amount transferred to other facilities (the amount sold and the amount disposed of by waste disposal service providers).

Storage of PCB Waste Materials

At each research base and site, polychlorinated biphenyl (PCB) waste from condensers and transformers is stored as special management industrial waste in accordance with statutory guidelines. A Special Management Industrial Waste Manager inspects the stored PCB waste once a month to make sure it is properly stored.

In FY 2017 we analyzed PCB concentrations in waste materials (condensers, reagents, etc.) and classified the waste materials as PCB waste (high concentration or low concentration) or non-PCB waste. Non-PCB waste was disposed of as industrial waste; PCB waste was managed in accordance with the disposal plan. With a view to final disposal, products using PCBs were carefully recovered and inspected at each research base and site.

We are outsourcing the disposal of high- and low-concentration PCB waste to the Japan Environmental Storage and Safety Corporation (JESCO) and a licensed detoxification service provider to systematically complete the disposal within the period specified by law.

Storage and disposal of PCB-containing items and PCB waste

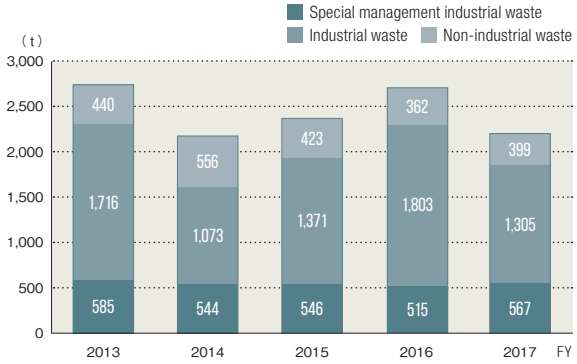
Waste type	Quantity stored at the end of FY 2016	Quantity added in FY 2017	Quantity disposed of in FY 2017	Quantity stored at the end of FY 2017
Condensers	20	15	15	20
Stabilizers	1,723	25	0	1,748
Transformers	7	0	1	6
Oils/paints (L)	106	0	0	106
Other contaminated materials	Stored as research chemicals, etc.	—	38kg of research chemicals disposed of	Stored as research chemicals, etc.

Reduction in Waste Generation

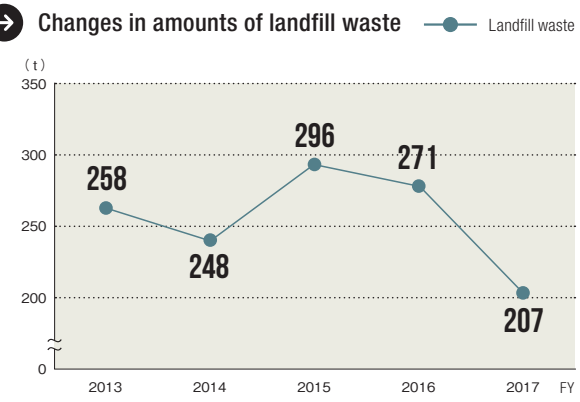
AIST seeks to reduce waste by applying the 3R (Reduce, Reuse and Recycle) principles and thus to reduce environmental burdens loads. We are focusing particularly on the reuse of research equipment, because this reuse can also contribute to cost savings (see “Effective Use of Resources” on the following page).

As part of our responsibility as a waste generator, every year we conduct on-site inspections of waste treatment facilities to make sure the waste is appropriately treated. In FY 2017, we conducted on-site inspections of 28 intermediate waste treatment and landfill facilities. In order to reduce landfill waste, we are working on reuse and recycling of waste materials.

Changes in amounts of disposed waste



Changes in amounts of landfill waste



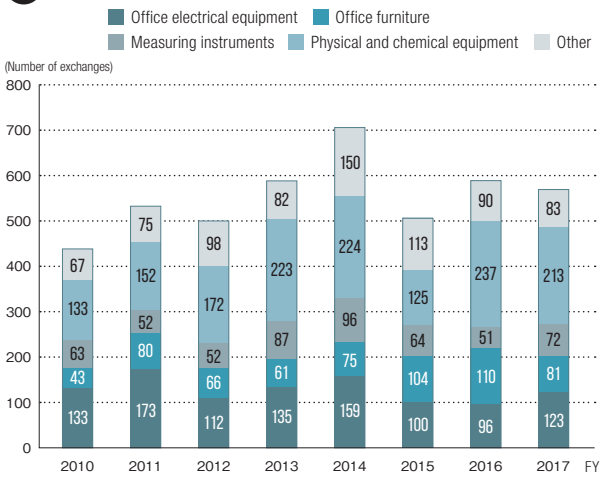
Breakdown of generated waste (FY 2017)

Waste type	Amount disposed of (t)	Amount landfilled (t)	Percentage of waste landfilled (%)
Non-industrial waste	567	106	18.7
Industrial waste	1,305	87	6.7
Plastic waste	283	28	9.9
Metal scrap	332	2	0.6
Sludge	167	27	16.2
Glass/concrete/ceramic waste	54	14	25.9
Slag	55	0	0
Other	414	16	3.9
Special management industrial waste	399	14	3.5
Flammable waste oil	16	5	31.3
Strong acids	287	4	1.4
Infectious waste	20	1	5
Waste oil (hazardous)	9	0	0
Sludge (hazardous)	6	0	0
Acid waste (hazardous)	10	0	0
Other	51	4	7.8
Total	2,271	207	9.1

Effective Use of Resources

Since 2005, an AIST intranet-based article recycling system has been in place to exchange information on wanted and available items, including research equipment, office electrical equipment, furniture and consumables, to promote reuse within AIST. We also give away items no longer useful in AIST to external organizations. In these ways we facilitate the reduction and reuse of waste.

Exchanges of items for reuse



Conservation of Water Resources

For the efficient use of water resources at Tsukuba Central and AIST Tokyo Waterfront, research wastewater is neutralized, treated with reducing agents, and reused for cooling laboratory equipment and flushing toilets.

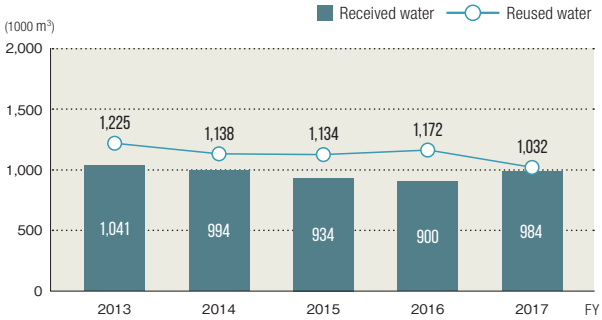
Breakdown of water received in FY 2013–2017

Unit: 1000 m³

FY	2013	2014	2015	2016	2017
Potable water	1,003	964	914	881	968
Groundwater	38	30	20	19	16
Industrial water	0	0	0	0	0
Total	1,041	994	934	900	984

Water reuse plant at AIST Tsukuba

Changes in amounts of water received and reused



Compliance with the Convention on Biological Diversity and the Cartagena Act: Welfare and Management of Animals

In 1992, the Convention on Biological Diversity for conservation of biodiversity and sustainable use of biological resources was adopted. The Cartagena Protocol was subsequently created to protect biodiversity through the safe transport, handling and use of living modified organisms that could have adverse effects on the conservation and sustainable use of biodiversity. In Japan, the Act on the Conservation and Sustainable use of Biological Diversity through Regulations on the Use of Living Modified Organisms (the Cartagena Act) came into effect in 2004. To comply with international rules based on the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (Access and Benefit Sharing (ABS)), which was adopted in 2010, AIST drew up "Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization Guidelines" (ABS Guidelines) in 2017.

To comply with the Cartagena Act, AIST holds committee meetings attended by external experts to conduct preliminary reviews of experiments involving living modified organisms and the handling of living modified organisms. In addition, to obtain the knowledge needed for compliance and to conduct appropriate experiments, AIST requires the researchers and the research support staff involved with these experiments to undergo education and training once a year. There were 195 such experiments in FY 2017. We conduct yearly on-site inspections of all laboratories that use living modified organisms, to ensure that the organisms are labeled as specified in the act, that they are managed correctly, and that containment measures are taken to prevent dispersal of the organisms. We also provide on-site guidance as needed.

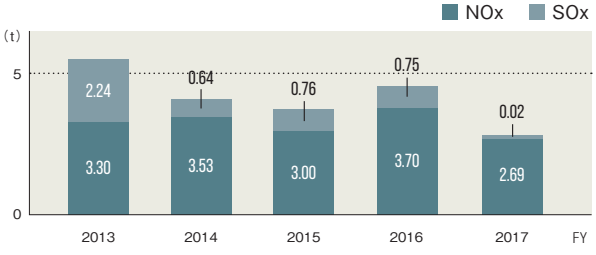
To comply with the Nagoya Protocol, AIST set up a consultation service in the research planning office of the Department of Life Science and Biotechnology in February 2017; it responded to 12 enquiries in FY 2017.

When experiments on animals are conducted at AIST, the experimental design is reviewed in advance by a committee attended by external experts with consideration for the 3R principles (Replacement, Reduction and Refinement) outlined in the Act on Welfare and Management of Animals. The results of annual self-assessments conforming to "Standards Relating to the Care and Management of Laboratory Animals and the Alleviation of Pain" are posted on a public website. Since 2016, we have been subject to external inspections and certification by the Japan Health Sciences Foundation.

Prevention of Air Pollution

The major sources of air pollutants at AIST are the boilers used as cold and heat sources for air conditioning. To reduce sulfur oxide (SOx) emissions, we mainly use city gas and kerosene as fuel for the boilers. Twice a year (once for heating boilers) we measure the concentrations of NOx and SOx in the effluent gases produced. The measurement results were all within the limits specified in the Air Pollution Control Act.

Changes in atmospheric environmental loads



*Limits specified in the Air Pollution Control Act
SOx: 0.21–17.97 m³N/h NOx: 150–600 ppm

Releases of Fluorocarbons

In accordance with the Act on Rational Use and Proper Management of Fluorocarbons, AIST checks for releases of fluorocarbons in periodic inspections and spot checks of refrigeration and air conditioning equipment and the like, with the aim of restricting emissions of fluorocarbons into the atmosphere. In FY 2017, during recovery and refilling of refrigerants in air conditioners and the like at Tsukuba Central 1 and AIST Kyushu, about 37 t-CO_2e of HCFCs*1 and about 223 t-CO_2e of HFCs*2 were released, a total of about 259 t-CO_2e.

Estimated releases of CFCs (FY 2017)

Type	R-number	Estimated t-CO_2e released by R-number	Estimated t-CO_2e released by type
HCFC	R22	36.6	36.6
HFC	R23	0.4	222.5
	R404A	1.1	
	R407C	68.6	
	R410A	152.4	
Total			259.1

*1: HCFCs are refrigerants classified as specified fluorocarbons that damage the ozone layer.

*2: HFCs are refrigerants classified as CFC substitutes that do not damage the ozone layer. However, they are powerful greenhouse gases and are being progressively replaced with non-fluorocarbon refrigerants.

Prevention of Water Pollution

At AIST, the fourth and subsequent washing waters from laboratories are sent as research wastewater to wastewater treatment plants. The wastewater undergoes processes such as pH adjustment, coagulation and sedimentation, filtration, and activated charcoal absorption to meet municipal effluent standards. It is then discharged into the public sewerage system.

To prevent water containing hazardous substances from leaking into groundwater, AIST conducts periodic inspections of buried research wastewater pipes in accordance with the Water Pollution Prevention Act. The results of the periodic inspections were that damage was discovered in some pipes at AIST Hokkaido and AIST Tsukuba. However, it was verified that only water from the fourth and subsequent washing waters that did not contain hazardous substances had been discharged; there was no pollution of groundwater or soil.

Wastewater treatment plant at AIST Tsukuba

Monitoring of groundwater at AIST Kansai and AIST Chubu

Arsenic exceeding groundwater standards was detected in a groundwater survey conducted in April 2012 at AIST Kansai. Hence, the water quality of groundwater observation wells has been measured on a regular basis under the guidance of the government of Ikeda City, where AIST Kansai is located. We will continue this monitoring.

Fluorine and fluorine compounds exceeding the standards were detected in the soil at AIST Chubu in a survey conducted in June 2012. Under the guidance of the government of Nagoya City, where AIST Chubu is located, one groundwater observation well was drilled and the water quality of the groundwater is measured once a year to prevent the spread of contamination. In the measurements of water quality taken in FY 2017, no particular issues were identified. We will continue this monitoring.

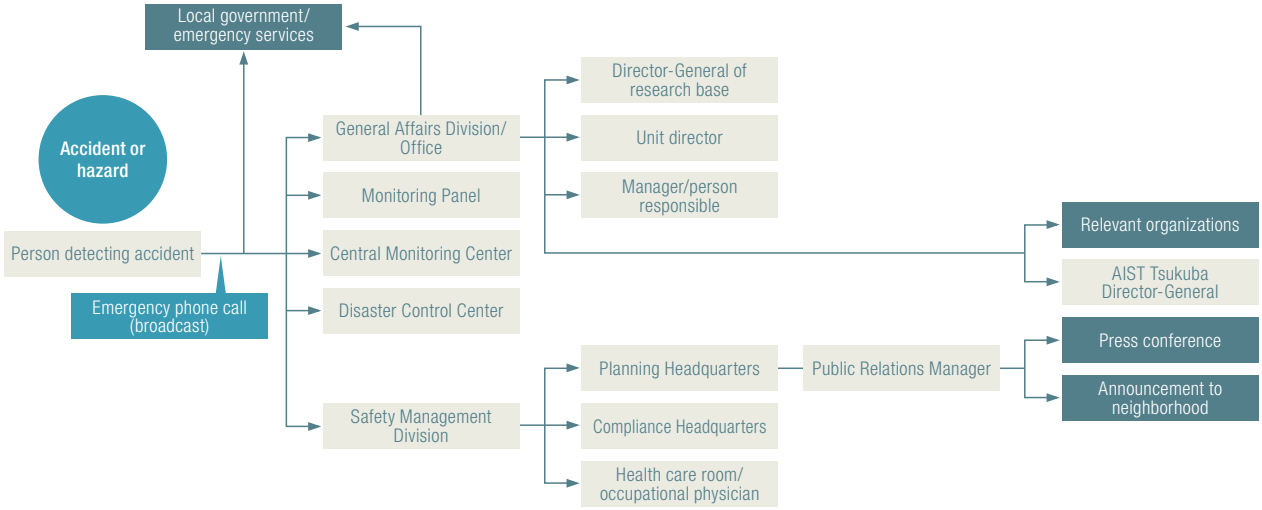
Results of groundwater analysis at AIST Kansai (units: mg/L)

Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)	Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)
April 2017	0.018	October 2017	0.024
May 2017	0.008	November 2017	0.006
June 2017	0.008	December 2017	0.019
July 2017	0.021	January 2018	0.038
August 2017	0.005	February 2018	0.008
September 2017	0.010	March 2018	0.007

Accidents Affecting the Environment

To ensure compliance with environmental laws and regulations, AIST has an Environmental and Safety Management System (ESMS) in place. No accidents occurred in FY 2017. We have a system to minimize damage in the event of an accident.

AIST Tsukuba Central Emergency Contact System



Drills to prepare for environmental accidents

AIST conducts contact, communication, and emergency action drills to minimize damage in the event of an environmental accident such as a leakage of oil or a chemical. In FY 2017, we conducted 17 accident drills across all research bases on events such as leakage of hazardous materials from rooftop flue gas-cleaning equipment and leakage of research wastewater during transport. We will continue to conduct drills for various environmental accidents on a regular basis.

An environmental accident drill

Environmental accident drills in FY 2013–2017

FY	2013	2014	2015	2016	2017
Number of drills	7	10	20	18	17

Noise Measurement

To prevent the noise generated by research institutions and facilities from adversely affecting the surrounding environment, AIST conducts voluntary periodic measurements of noise at all research bases. The results in 2017 showed that there were no adverse effects outside any research base.

Reports on Accidents that Occurred in FY 2017

Oil leak at AIST Tsukuba Central 5

On March 27, 2018, an oil leak was caused by a malfunction of compressed air equipment (a compressor) at AIST Tsukuba Central 5. Some of the leaking oil spilled into a rainwater drainpipe and flowed out of the site. The leak was estimated at no more than 1 L, with a concentration of n-hexane extracts in the effluent water of 3.2 mg/L (the standard limit is 3 mg/L). The leaked oil contained no hazardous substances. After the accident, the compressor was promptly stopped and Tsukuba City government was informed. The compressor remained stopped while rainwater pipes and inlets were cleaned. The cause of the accident is thought to have been ageing of the compressor. We will seek to avoid a future recurrence of such accidents by such measures as periodic checks paying particular attention to compressors that may be ageing.

Fire at AIST Tsukuba Central 1

On November 27, 2017, at AIST Tsukuba Central 1, a fire was caused by a short circuit in a store-bought lithium-ion battery. The fire was quickly put out and damage was minimal. A recurrence will be prevented by workplace guidelines and enhanced education. In addition, cautions about the use of lithium-ion batteries have been distributed in the institute.

Complaints from neighborhood residents

AIST Hokkaido and AIST Kansai received one complaint each from neighborhood residents about overgrown branches or trees; measures were taken to prevent further complaints.

Third Party Views

The AIST Report 2018: Social and Environmental Report

Director, Workers Club for Eco-harmonic Renewable Society (NPO)

Tamio Yamaguchi

In writing this Third Party View, I went through two rounds of discussions, submitting comments on an early draft of the AIST Report, receiving responses, and reading through the final version of the AIST Report. In the discussions, I had the strong impression that rather than the organization being fixated on its own internal values or character as a research institute, instead it had a strong interest in domestic and international trends. The way this organization works may show the way to achieve its mission, "in society, for society." The managers I dealt with gave thoughtful responses to my comments. While there were some points of disagreement with my opinions, I believe that discussing these differences is one of the ways to achieve the mission.

There has been a succession of gloomy reports on Japan's research environment in recent years. For example, regarding the productivity of research, Japan produces the lowest number of papers per unit expenditure among the nine most-developed nations. Regarding numbers of high-impact papers, ten years ago Japan was in fourth place behind the USA, the UK and Germany, but now Japan has fallen to ninth place. Moreover, Japan is the only one of the top nine nations in which the number of research-based master's degrees and doctorates proportional to population has fallen. In identifying the factors that have brought about the situation, many observers have pointed to research fields being silos that are isolated and conformist, the low mobility of researchers, and how young researchers are treated.

The President's Message offers a strong commitment to overcoming these problems, saying "AIST should be a research institute of 'multiple open platforms' driving R&D of international standards, conducting cooperative research with universities and other research institutes, and actively engaging in collaboration with business. We should ... support industrial development in Japan." As measures to realize this commitment, this report discusses AIST consortiums, technological research associations, business–academia collaborations, international collaborations, and the employment of researchers from overseas. Staff training measures can also be seen, such as the AIST Innovation School and the research assistant system, easing the financial burden of postgraduate studies and nurturing high-level research talent. Reading about these gives me hope for a recovery in Japan's research capabilities and revitalization as a scientific nation.

The Research Reports are always well worth reading. In recent years, there have been international moves towards challenging and ambitious goals, such as the SDGs and the Paris Agreement, that surpass cautious approaches to business-as-usual projections from current conditions. The Research Reports mention the design concepts governing ideas about how technologies responding to this movement will affect social issues and hence the world. The President's Message touches on this: "The achievements of science and technology are making life more comfortable, but the costs of industrial development are also becoming clearer." When the new technologies, goods and services resulting from R&D are provided to society, they ameliorate social problems and contribute to personal happiness, but may also impose burdens on society and the environment. Consequently, businesses emerge that are directly concerned with the burdens and focus on innovations that will moderate or overcome the burdens. I think it is crucial for the effects of these burdens to be identified and addressed at early stages by research institutes. For researchers, it is essential that research ethics always take account of the negatives inherent in technology along with potential uses. I feel that there has been little discussion of this point in previous annual reports.

For years, open days for the public have been held at various sites in Japan; would it be possible to use these events for two-way scientific communication between researchers and the public, including discussion of the negatives? This is one of the reasons why the scientific and technical literacy of we the public must be improved.

I finish with a list of major issues of concern about AIST. I hope that these issues will be taken up and addressed in detail in future annual reports: fairness and transparency in research activities; research working environments; the rights of researchers; and contributions to the SDGs.

Workers Club for Eco-harmonic Renewable Society (Junkan Workers Club): A citizens group that investigates, with a global perspective, the form of a society in harmony with the natural ecosystems that will be passed on to the next generation. The goal of the club is to study, support and put into practice measures by regional citizens, businesses and governments leading to a sustainable society. At the club's internal sCSR workshops, the group studies and proposes appropriate forms of CSR.
URL: junkanken.com

●On the publication of the AIST Report 2018

Deputy Director-General, Planning Headquarters **Haruhiko Obara**

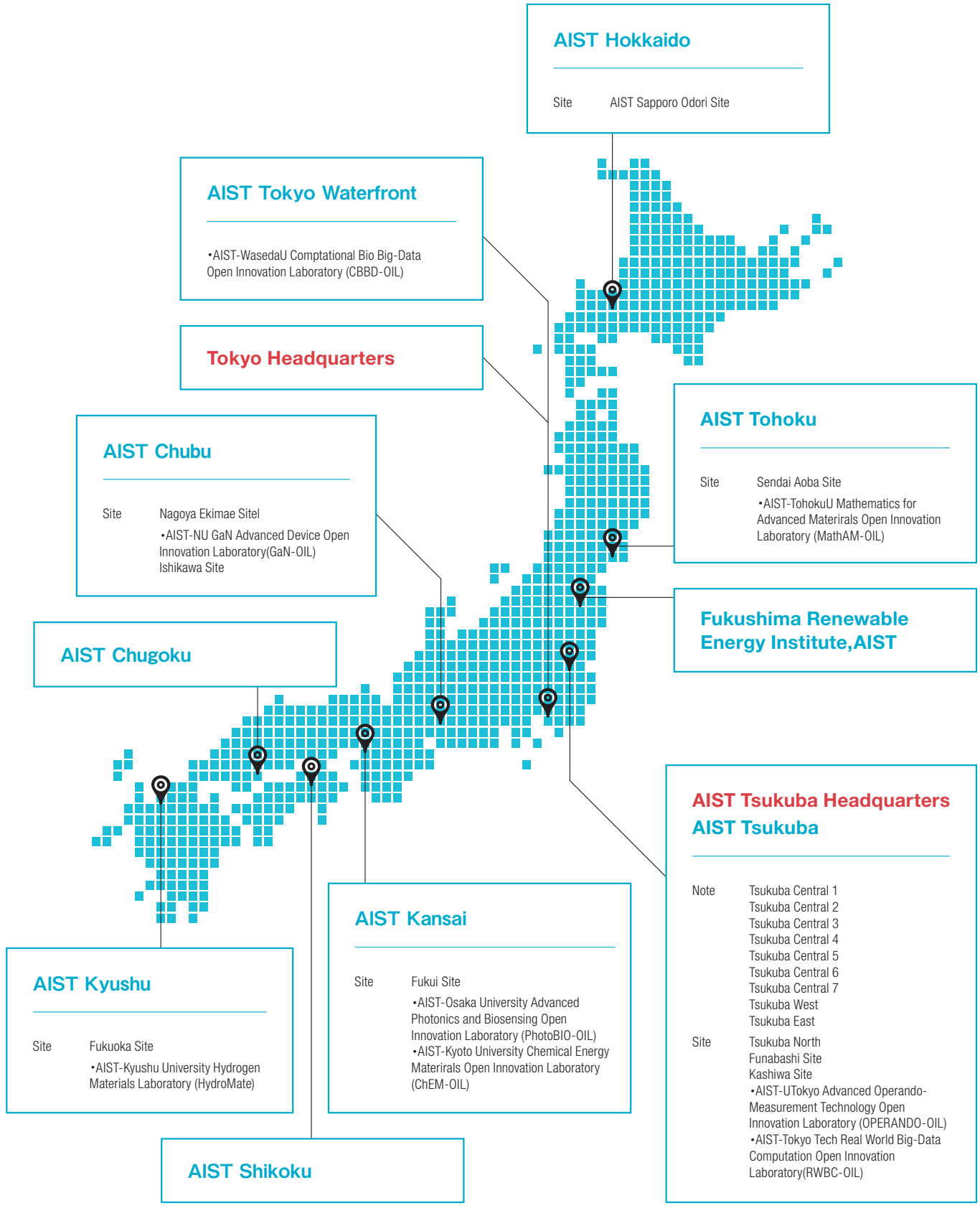
AIST has been publishing environmental reports since 2004, compiling and publishing the AIST Report: Social and Environmental Report in accordance with ISO 26000. Since 2010, the scope of the report has widened to cover research bases across the country in addition to AIST Tsukuba, and reports on initiatives relating to the environment, workplace safety and health, and corporate social responsibility (CSR) have been added.

In this year's AIST Report, the Opening Interview covers work by the NMIJ on revisions to the International System of Units (SI), which will have great effects on society. In the Research Reports, high-grade recycling technology of rare metals is discussed in relation to helping build a sustainable society. These efforts are also mentioned in the President's Message from Ryoji Chubachi as contributions towards the United Nations' Sustainable Development Goals (SDGs). The report introduces other recent research results that have attracted interest, such as a protein structure analysis technique for the development of new drugs and a new theory on deformation of the Earth's crust in the Japanese archipelago. The activities of AIST consortiums, set up and managed by AIST as research societies with different themes, in promoting research and innovation are also reported on. In Third Party Views, Tamio Yamaguchi of the Junkan Workers Club offers invaluable opinions and guidance arising from many discussions.

For AIST, with the motto "in society, for society," it is our duty and our mission to present AIST's activities to the many stakeholders who want to hear about them in a form that is easy to understand. With this report, we are striving to connect to build relationships of deeper trust with society.

Research Bases

as of Sept.30,2018



AIST Hokkaido

Site AIST Sapporo Odori Site

AIST Tokyo Waterfront

•AIST-WasedaU Comptational Bio Big-Data Open Innovation Laboratory (CBBD-OIL)

Tokyo Headquarters

AIST Tohoku

Site Sendai Aoba Site

•AIST-TohokuU Mathematics for Advanced Materirals Open Innovation Laboratory (MathAM-OIL)

AIST Chubu

Site Nagoya Ekimae Sitel

•AIST-NU GaN Advanced Device Open Innovation Laboratory(GaN-OIL)
Ishikawa Site

Fukushima Renewable Energy Institute,AIST

AIST Chugoku

AIST Tsukuba Headquarters
AIST Tsukuba

Note Tsukuba Central 1
Tsukuba Central 2
Tsukuba Central 3
Tsukuba Central 4
Tsukuba Central 5
Tsukuba Central 6
Tsukuba Central 7
Tsukuba West
Tsukuba East

Site Tsukuba North
Funabashi Site
Kashiwa Site

•AIST-UTokyo Advanced Operando-Measurement Technology Open Innovation Laboratory (OPERANDO-OIL)

•AIST-Tokyo Tech Real World Big-Data Computation Open Innovation Laboratory(RWBC-OIL)

AIST Kansai

Site Fukui Site

•AIST-Osaka University Advanced Photonics and Biosensing Open Innovation Laboratory (PhotoBIO-OIL)

•AIST-Kyoto University Chemical Energy Materirals Open Innovation Laboratory (ChEM-OIL)

AIST Kyushu

Site Fukuoka Site

•AIST-Kyushu University Hydrogen Materials Laboratory (HydroMate)

AIST Shikoku

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