

Full Research in Society, for Society



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Society and Environmental Report





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 2020 Social and Environmental Report provides easily comprehensible introductions to leading-edge research activities for solving social issues, including an interview with the Director of the Global Zero Emission Research Center on environmental issues, and topics categorized for different readers such as people related to industry-academia-government collaboration, workers, and people of regional society. 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/

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- Activities covered by the report
Research activities at all AIST research bases
 - Period covered by the report
April 2019 to March 2020
 - 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
 - 2018 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
 - Global Reporting Initiative
 - Scheduled date of the next edition
September 2021 (Japanese edition)

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Leading the World in Continuing to be In Society,

Since its establishment as an independent administrative agency in 2001, the National Institute of Advanced Industrial Science and Technology (AIST) has been continuously active in advancing industrial technology, developing new industries, helping to build intellectual infrastructure, growing the national economy, and helping to improve people's lives.

Nineteen years on, Japan is facing a range of societal problems that are hard for individual organizations and research specialisms to tackle, such as energy and environmental constraints, the aging and shrinking population, natural disasters, and the pandemic. Solutions to these problems are strongly needed. Against this background, AIST embarked on its Fifth Medium- to Long-term Plan in 2020, to make use of our collective strength to meet the needs of the nation and society and, through collaborations and synergies between the diverse researchers and research fields in the Institute, to deepen our collaborations with industry, academia and government and expand social applications of research outcomes.

The United Nations adopted the Sustainable Development Goals (SDGs) in 2015. The SDGs are making people more and more sensitive to the sustainability of society and many companies have adopted them as business targets. AIST, as a National Research and Development Agency aiming to build a society in which citizens can live prosperously and safely, is subject to high expectations and declared “world-beating solutions to societal problems” as a mission in the Fifth Medium- to Long-term Plan. We will have to strive with all our strength to achieve this.

For example, since the novel coronavirus (COVID-19) rampaged across the world in early 2020, AIST has been running various projects such as searching for candidate drugs, developing fast and accurate testing equipment, and establishing international standards for testing technology.* We are not just taking action against the disease itself; at the same time we are working on wide-ranging R&D to help society live with COVID-19 and strike

Meeting the Challenges of Society

For Society

a balance between infection control and safe, worry-free economic activity. This R&D includes using artificial intelligence (AI) for simulations of epidemic spread and evaluating transmission risks in real-world environments.

Meanwhile, one of the most serious challenges of the 21st century is climate change. To bring about revolutionary innovations to tackle the climate change problem, AIST opened the Global Zero Emission Research Center in January 2020. There we will gather the world's knowledge and work on the development of basic technologies to achieve a sustainable society. Concerning research in the clean energy field progressing around the world, we hosted the RD20 international conference to bring together leaders from national research institutes of the G20 nations, and we are promoting innovation to solve problems at the global scale by further strengthening international collaboration.

We recognize that tackling societal problems at the global level is one of the purposes of a public research institute such as AIST. We will continue to actively apply AIST's knowledge to solving various societal problems.

When facing problems that are too large for a single organization to tackle by itself, exerting synergistic effects from multifaceted collaborations is important. AIST has previously set up collaborative research bases to provide structures for open innovation, such as the Open Innovation Laboratories with universities and Cooperative Research Laboratories with companies. From 2020, by combining basic research by universities, social application by companies, and the collective strength of the seven research domains of AIST, we will achieve leverage such that $1+1+1$ is not 3 but becomes 10 or 20. Thus, we will accelerate our efforts to lead the world in solving societal problems.

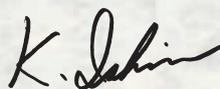
This report outlines AIST's new efforts and our activities in FY 2019. The articles in this year's report are organized around four themes: AIST and environmental problems; AIST and industry-

academia-government collaborations; AIST and the AIST staff; and AIST and regional communities. It describes major research activities, new collaborations with other organizations, and our efforts in many institutional matters: governance and welfare programs; staff training initiatives; support for a proper work-life balance; and the promotion of diversity by means such as supporting the participation of female staff and foreign researchers, and recruiting people with disabilities. Our efforts in strengthening compliance, environmental safety management, and the establishment of fair business practices such as reasonable procurement are also discussed. AIST is improving its research activities, presenting its activities to society, and enhancing the transparency of its activities. In this way, AIST is raising the understanding of stakeholders, winning trust from society, and improving the effectiveness of its research.

At the moment, as the disruption caused by the pandemic continues, developing new drugs and preventive measures and producing innovations to enable new lifestyles, such as through digital transformation, are urgent challenges. To respond to the pressing needs of society, AIST will continue to work diligently to solve societal problems "in society, for society."

We look forward to your continued understanding and support.

National Institute of Advanced Industrial Science and Technology (AIST)
President



ISHIMURA Kazuhiko

*: For details, see "In society, for society: Research activities for tackling COVID-19"
https://www.aist.go.jp/aist_e/covid-19/index.html

We have also taken on a number of projects under the FY 2020 Program to Develop Countermeasure Technologies against Viral and Other Infectious Diseases; we are supporting empirical and modification research and supporting basic research.

Collecting the world's wisdom at the Global Zero Emission Research Center

The Fourth Industrial Revolution: The Ace Card to Beat Environmental Problems?

Global environmental problems are among the 21st century's most serious problems and require ground-breaking innovations. To produce these innovations, the Global Zero Emission Research Center (GZR) was established in January 2020 and Dr. Yoshino Akira was appointed Director of the Center.

Dr. Yoshino has sent powerful messages to the world, saying that the Fourth Industrial Revolution will lead to solutions for global environmental problems. We asked him about the road to technological innovation, the coming transformations of industrial structure, and the role that GZR will play.

Great changes to society coming after 2025

Q: Firstly, can you describe a scenario for overcoming global environmental problems?

Yoshino: I see milestones in the years 2025, 2030 and 2050. Technological innovation will be vital to solving global environmental problems. The current global trends are for rapid progress in technological research in fields such as AI (Artificial Intelligence), IoT (Internet of Things) and 5G. According to various development roadmaps, the technologies required to get the sustainable society started must broadly be available by around 2025. This will be the start of the Fourth Industrial Revolution. Five years after that, 2030, is when society will begin to make progress in deploying the new technologies. After that, we will steadily cut the rate of addition of CO₂. Perhaps we will be able to say we have achieved a sustainable society around 2050.

The First Industrial Revolution and the Second Industrial Revolution brought us mass production and mass consumption but left a destructive legacy of global environmental problems. Following on from the

Third Industrial Revolution (the digital revolution), in the Fourth Industrial Revolution new technologies including AI, IoT and 5G will start working to solve global environmental problems effectively. In the society of the future, I am certain that products that only promise convenience will not sell; only products that can be described as making significant contributions to the global environment will be big successes. In this way, the Fourth Industrial Revolution will interact intimately with global environmental problems, although as yet nobody can clearly see how they will be coupled.

Business opportunities in global environmental problems

Q: How will industrial structure change?

Yoshino: Five to ten years ago, industry took a defensive stance of trying to at least avoid blame from society for global environmental problems. In the last few years, industry has switched to a more proactive stance, seeing the changes in global industrial structure caused by global environmental problems as golden



PROFILE

Global Zero Emission Research Center

Yoshino Akira, Doctor of Engineering

M.S., Department of Petrochemistry, Graduate School of Engineering, Kyoto University; Honorary Fellow, Asahi Kasei Corp.; Fellow, AIST; President, Lithium Ion Battery Technology and Evaluation Center (LIBTEC); Distinguished Professor, Meijo University; Distinguished Professor, Kyushu University

His pioneering research into lithium ion rechargeable batteries and the resulting excellent outcomes in technological development are highly esteemed. He was awarded the Nobel Prize in Chemistry in 2019.

business opportunities. I think this attitude is correct. While there will naturally be industries that disappear, new industries will emerge in their place.

If technological development actually turns out to be the ace card to beat global environmental problems, those technologies will certainly become global standards. Japan must not be late to the table and, where possible, I want Japan to be out in front. This is the forward-looking stance that Japanese industry is adopting.

In the digital revolution, the GAFA tech giants (Google,

Amazon, Facebook and Apple) have occupied the best positions and are now setting global standards. The same thing will definitely happen again in the future. I want to see Japanese tech giants emerging from the Fourth Industrial Revolution.

Q: What of the future of the automotive industry, which is a key industry for Japan?

Yoshino: What I anticipate is a future in which driverless autonomous electric vehicles equipped with AI (AIEV) will be widely used as car-sharing vehicles. If this kind

of car society is realized, cars will be very profitable to operate. In contrast, simply making and selling cars as we have till now is not good enough (laughs). The traditional business model will be transformed and a new industry will emerge. I think, therefore, that this is a golden opportunity for the automotive industry.

In regard to the global environment, a global CO₂ saving of around 50% will be possible if cars and electricity generation are linked. If lithium ion batteries mounted in AIEVs can be employed as an electricity storage system, this will make a great contribution to the global environment without requiring massive investments in infrastructure.

However, privately owned cars cannot be arbitrarily charged and discharged for electricity supply. Therefore, a precondition is that the AIEV car-sharing I mentioned becomes widespread. If the technology of electric vehicles is combined with AI, IoT and 5G, then there could be a situation in which, for example, the government sends out an order during an emergency and power is drawn from all car batteries. We should be able to picture this kind of situation in more concrete detail after 2025.

Seeing the future by taking a broad perspective on currents in society

Q: What is needed for Japan to take the initiative in these new trends?

Yoshino: There are two requirements: the first is technological innovation and the second is creating new social systems to use the technologies. If we speak in terms of upstream and downstream, the upstream side is technological innovation and the downstream side is big tech businesses.

Therefore, what is important is the ability to coordinate. If we only think about technologies, there is a danger that we will not relate them to the future. We must visualize conditions in 2025, 2030 and 2050 and pursue research with a view to how to realize them. It is also vital to be aware of what ordinary people are asking for.

Q: Is that something you learned from your experiences in industry?

Yoshino: In industry, basic research, commercialization and market launches are usually conducted by different specialists. In my case, however, I was involved with lithium ion batteries at every stage and I was able to observe the digital revolution across the process. I think that those experiences were significant.

If we pinpoint the start of the digital revolution as 1995, after a long preparation period, the whole world moved on the same course at the same time. The currents of the Fourth Industrial Revolution will probably be similar. Although the lead time to start movement on global environmental problems is long, I think movement will be fast once a course has been set.

Q: What attitude should researchers have in order to bring technologies to commercialization?

Yoshino: First, researchers must be relentless in producing their own ideas. Second, they should ask whether a technology will actually be required five or ten years in the future. Sometimes, they should abandon a pet project and change course. For research results to lead to final outcomes, researchers must switch direction from time to time in response to changes in society.

Q: Do you have any advice for researchers tackling solutions to global environmental problems?

Yoshino: When thinking about global environmental problems, I think it is useful to know about geophysics and biophysical chemistry. For example, fossil fuels are sustainable resources that were created by photosynthesizing organisms in the far distant past. The problem is that we are burning them; in essence they are actually sustainable.

One thing that I really want to discuss with everyone in AIST is what kinds of photosynthesizing organisms lived in that past when the CO₂ concentration was tens of percent. How is it that today's photosynthesizing organisms can photosynthesize well with CO₂ concentrations of around 400 ppm? If we think about these things with a long perspective, I suspect that we will find hints about global environmental problems.

Managing international cooperation from the GZR

Q: I would like to ask about GZR, the Global Zero Emission Research Center. What distinguishes GZR and what does it offer the world?

Yoshino: We set up GZR with the objective of technological innovation aimed at global carbon neutrality, and then "beyond zero," in accordance with the government's Environment Innovation Strategy. We cover diverse research topics relating to zero emissions. Around the world, many different approaches are being tried. GZR will aggregate their results and connect 120,000 researchers around the world.

AIST encompasses a broad range of research relating to zero emissions and is equipped with research infrastructure. Obviously, global environmental problems cannot be solved by developing single technologies. We will consider many arguments and plot new courses, and we will adopt new approaches.

Q: As Director, how do you intend to steer GZR?

Yoshino: The important thing is to set one vector of R&D for every researcher to focus on. I think that solutions to global environmental problems basically require three elements: economy, convenience and environment.

The great difference from usual research activities is the dividing line between the cooperative and the

Yoshino Akira



competitive. For example, there is currently fierce competition between countries in the development of a COVID-19 vaccine but it would be most efficient if the world had cooperated on development from the start and distributed the results equitably.

In the same way, cooperation must be given great weight against global environmental problems. From the start, GZR has been a project of temporarily putting aside individual interests, first diligently producing results and only thinking about the distribution of benefits when the time comes. This kind of management is important for an international organization.

Q: How is lithium ion battery R&D progressing at GZR?

Yoshino: Firstly, lithium ion batteries will ultimately be a supporting player against global environmental problems. For example, I think they will be positioned in the background as support for renewable energies with large variable factors, such as wind power and solar power.

Regarding future R&D, the requirements of lithium ion batteries will certainly change by the dates I mentioned at the beginning, 2025, 2030 and 2050. As the technologies of AI, IoT and 5G progress, directions of development will change accordingly. Previously, the primary requirement was energy density, the second was cost, and the third was durability. After 2025, it is likely that this order will change and the importance of durability will increase.

Research is now moving fast in various fields, including all-solid-state batteries. All-solid-state batteries have great potential and in theory will radically improve durability, but they still have many issues such as physical deterioration and the technologies needed for mass production.

Using upstream strengths to improve the future of humanity

Q: What path should Japan follow as a technological nation?

Yoshino: Japan, both now and in the future, has absolute strengths on the upstream side. Upstream products are not possible without accumulated learning, and accumulated learning implies experiences

of great failure. As times change, the technologies that will be best for completely different applications are hidden in those experiences. Whether we can make good use of this valuable negative data is an important question.

Another question is what we should do on the downstream side, where Japan has been weak in the past. Maybe the direction of Japan should be imagined as following the Apple model. The Apple model is of an integrated business, from making to using products. By contrast, the Google model is not of making products but of dominating the world by distributing Android for free, which is an incredible idea. This absolutely could not be conceived from the upstream side. Given this, it seems that the Apple model, leveraging upstream strengths, is more appropriate for Japan.

Q: Do you see a bright future for the world?

Yoshino: Humans are not stupid (laughs). I think the world is definitely moving in the right direction. Even global environmental problems, if you look ahead, mean excellent business opportunities.

But while adults can afford to take that attitude, there is a problem for children. Global environmental problems are a psychological burden for them. Therefore, I would like adults to offer the children of the world reassurance that, although it will take time, this path should show us some solutions by around 2025 and that many people, including the scientists at AIST, are working hard on the problems.

For a more detailed message, visit this website (Only in Japanese) ► https://www.aist.go.jp/aist_j/aistinfo/aist_report/intent.html

Introduction to research at the Global Zero Emission Research

01 Organic-inorganic Hybrid PV Team

Mission

To promote the use of renewable energy for primary power sources by facilitating the commercialization of efficient power generation from solar energy falling on diverse locations.

Outline of specific technologies and research themes

- Developing materials and processes for innovative solar cells (perovskite PV) with super light weight and super high efficiency
- Developing low-energy fabrication technologies to reduce CO₂ emissions
- Application development of perovskite and organic solar cells

02 Multijunction PV Team

Mission

To enable wider use of new applications by developing low-cost, ultrahigh-efficiency multijunction solar cells for vehicles such as cars and UAVs (drones) and for mounting on building walls and such. To create new markets for solar power generation by developing solar cells with various advantages over previous solar cells, such as lighter weight, greater flexibility, and greater capacity with smaller area.

Outline of specific technologies and research themes

- R&D of low-cost fabrication techniques (hydride vapor phase epitaxy) for ultrahigh-efficiency III–V compound semiconductor solar cells
- Development of low-cost bonding technologies (smart stack etc.) for various kinds of solar cells
- R&D of innovative passivating contacts for Si solar cells
- Development of Si nanocrystal–perovskite hybrid solar cells
- R&D to improve the capabilities of wall-mounted Si solar cells

03 Thermoelectrics and Thermal Management Team

Mission

To promote non-wasteful utilization of energy by developing materials and technologies that enable direct conversion of waste heat to useful electricity.

Outline of specific technologies and research themes

- Improving the efficiency of thermoelectric conversion modules by forming nanostructures that suppress heat conduction but allow electricity to flow easily
- Developing novel thermoelectric conversion materials principally constituted of elements with few resource constraints
- Developing a reference module for thermoelectric conversion testing with excellent mechanical durability

04 Fundamentals of Ionic Devices Research Team

Mission

To promote CO₂ recovery and effective energy use by developing materials and technologies that efficiently convert electrical energy to chemical energy.

Outline of specific technologies and research themes

- Development of innovative technologies to efficiently convert CO₂, water and renewable energy to chemical materials
- Materials development based on electronic state analysis to realize safe, stable, high-performance electricity storage technologies; development of safety tests and operation methods

05 Artificial Photosynthesis Research Team

Mission

To enable wider use of artificial photosynthesis technologies for converting solar energy to chemical energy by researching economically practical fabrication techniques.

Outline of specific technologies and research themes

- Low-cost hydrogen production from a photocatalysis–electrolysis hybrid system: an original AIST technology combining electrolysis with a photocatalysis reaction using a redox medium such as iron ions
- Using semiconductor photoelectrodes and electrode catalyst technologies to produce hydrogen and useful high-added-value chemicals (hydrogen peroxide, hypochlorous acid, etc.)

06 Hydrogen Production and Storage Team**Mission**

To significantly reduce CO₂ emissions by developing technologies for hydrogen production, storage and use.

Outline of specific technologies and research themes

- Developing technologies for hydrogen production by direct decomposition of methane without emitting CO₂ as a byproduct
- Developing technologies for water electrolysis based on anion-exchange membranes
- Developing technologies for efficient production and use of energy carriers (ammonia, methane)
- Developing hydrogen storage technologies for constructing efficient energy storage systems
- Developing heat-resistant materials for hydrogen electricity generation
- Developing technologies for using liquid hydrogen

07 Carbon-based Energy Carrier Research Team**Mission**

R&D of energy storage (hydrogen) technologies based on interconversion between CO₂ and formic acid/methanol, to be used as effective CO₂ utilization technologies.

Outline of specific technologies and research themes

- Developing efficient catalysts that can produce formic acid or methanol by reducing CO₂ (hydrogenation, electro-reduction) and that can release hydrogen from formic acid
- Developing technologies for producing high-pressure hydrogen from formic acid

08 Smart CO₂ Utilization Research Team**Mission**

To significantly reduce CO₂ emissions by R&D of technologies for recycling and fixation.

Outline of specific technologies and research themes

- Developing innovative resource utilization technologies that can significantly reduce CO₂ emissions
- Developing CO₂ separation, recovery and fixation technologies to be basic technologies for CCUS (carbon capture, utilization and storage) and carbon recycling
- Developing chemical resource production technologies based on using CO₂ as a feedstock
- Developing technologies for expanding green resources through biotechnology and for capturing, fixing, and using CO₂

09 Resource Circulation Technology Research Team**Mission**

To ease the resource constraints of the critical metals that are necessary to achieve a zero emission society, by developing technologies that enable separation and recovery of metals from urban mines.

Outline of specific technologies and research themes

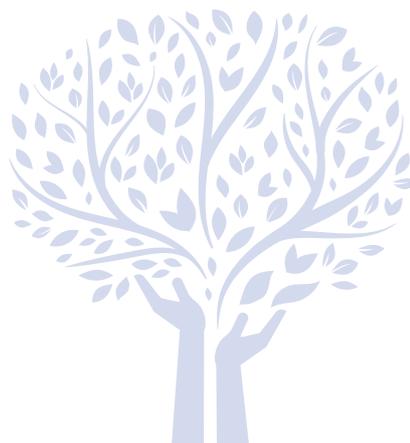
- Developing simple recycling processes for rare earth magnets
- Developing technologies for recovering rare earth elements from unused resources and recovering platinum group metals with low environmental loads

10 Environmental and Social Impact Assessment Team**Mission**

Creating scenarios of zero CO₂ emissions with the evaluation of new energy technologies.

Outline of specific technologies and research themes

- Developing LCA methods and tools to assess the feasibility of carbon recycling systems
- Developing methods and tools to assess the feasibility of mineral resources recycling systems that support low carbon technologies
- Developing energy models to investigate long-term scenarios
- Developing big data analyses that employ AI and IoT





AIST and Environmental Problems

To build a sustainable society, AIST brings the results of research and development to society. To incorporate environmental considerations into the research and development process, AIST has set an Environment and Safety Policy and complies with laws and regulations in its business activities.

See pages 50-53 for more details▶

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

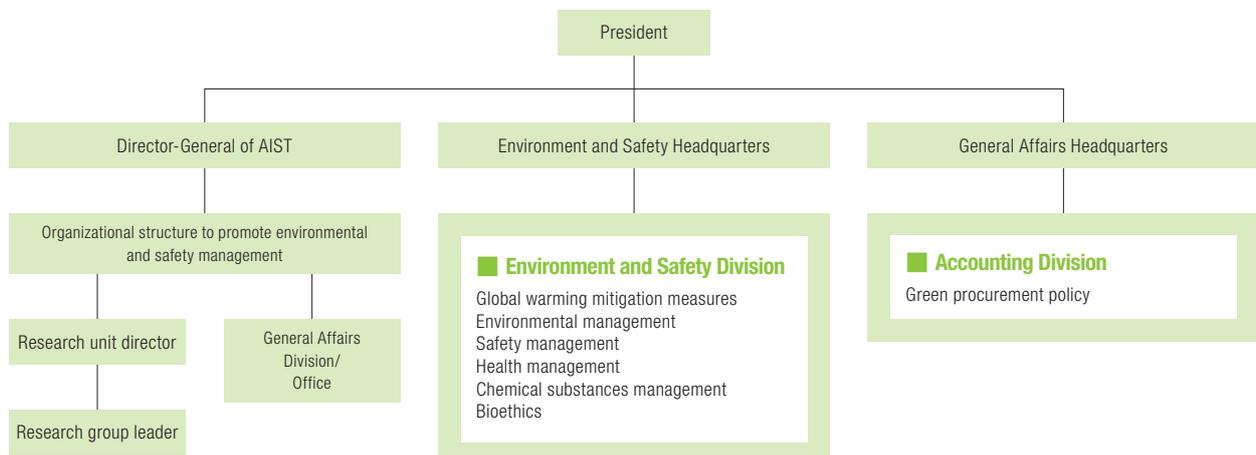
Safety Policy to proactively work with a keen awareness of the importance of ensuring global and local environmental conservation, and the health and safety of everyone working at AIST. This is done keeping in mind AIST's characteristic as a research institute that handles a wide variety of chemicals and poisonous substances.

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.

Implementation Structure of Policies Related to Environment and Safety

AIST's headquarters organizations and operating units work together closely to implement our environmental initiatives covering the whole of AIST.

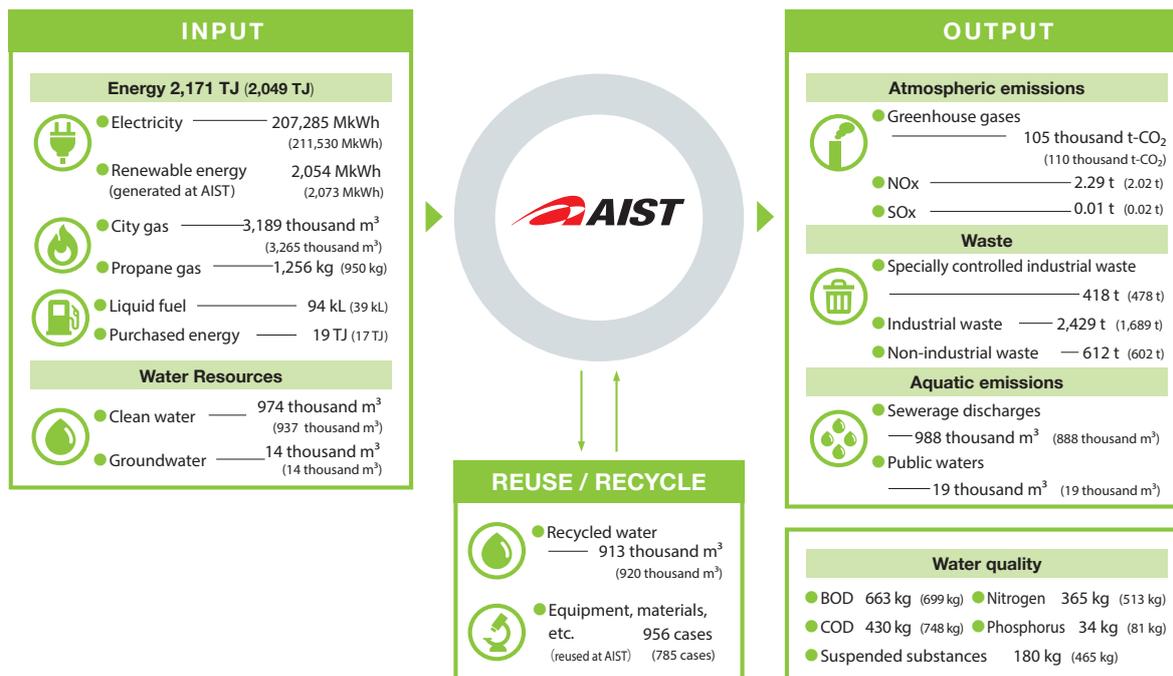


Environmental and safety management system

AIST has its own environmental and safety management system (ESMS) in place. It combines two subsystems: an environmental management system and an occupational health and safety management system.

Overview of Environmental Burdens

(): FY 2019 results



Appropriate Management of Chemical Substances

AIST has in place the Chemical and Gas Management System that enables management of possessed and used quantities of chemicals so that researchers can appropriately self-manage the wide range of chemicals used in research activities. Through this system, the management department strengthens management by understanding the quantity of chemicals possessed by researchers, reminding them of laws and regulations, and by alerting overly possessing chemicals.

● Response to PRTR system

Based on the PRTR system and ordinances of the Tokyo Metropolitan Government and the Osaka Prefectural Government, AIST grasps the amounts of chemicals discharged to the atmosphere and moved as sewage water or waste material. For FY 2019, hexane, hydrogen fluoride and aqueous salt, ferric chloride, N,N-dimethylacetamide are subjected in the PRTR system, acetone, chloroform, ethyl acetate, ethanol are subjected in the ordinance of Tokyo, and volatile organic compounds are subjected in the ordinance of Osaka.

Consideration for Biological Diversity

To comply with the Cartagena Act for the conservation of biological diversity, AIST requires the researchers and the research support staff involved with the experiments involving living modified organisms to undergo education and training, and holds committee meetings attended by external experts to conduct preliminary reviews of the experiments. We conduct on-site inspections of all laboratories involved to verify that organisms are managed correctly according to the law.

When experiments on animals are conducted at AIST, the experimental design is reviewed in advance for the 3R principles (Replacement, Reduction and Refinement) outlined in the Act on Welfare and Management of Animals, and the results of annual self-assessments are posted on our public website. Since 2016, we have been subject to external inspections and certification by the Japan Health Sciences Foundation.

Consideration for Water Resources

● Prevention of water pollution

At AIST, the fourth and subsequent washing waters from laboratories are sent to wastewater treatment plants and processed to abide by the Water Pollution Prevention Act and 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 builds dikes and conducts periodic inspections of buried research wastewater pipes and groundwater quality to check for abnormalities.



Wastewater treatment plant at AIST Tsukuba

● Use of reclaimed water

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



Water reuse plant at AIST Tsukuba

Consideration for Atmospheric Emission

● Reduction of fluorocarbon emissions

In accordance with the Act on Rational Use and Proper Management of Fluorocarbons, AIST requires periodic inspections and spot checks of refrigeration and air conditioning equipment that uses fluorocarbons as refrigerants, to restrict emissions of fluorocarbons into the atmosphere. In FY 2019, a total of about 792t-CO₂ was released, and it was less than the amount (over 1,000t) required to report under the Act.

● Prevention of air pollution

Regarding boilers as cold and heat sources for air conditioning that are major sources of NO_x and SO_x at AIST, we measure the effluent gases twice a year so that they do not exceed the emission standards under the Air Pollution Control Act. Regarding NO_x, in FY 2019, the measurement results were all within the limits. Of SO_x, there has been little emission since 2017, and the results fall far below the emission standard. In addition, when replacing equipment, we choose chiller units with high energy-saving effects and downsized units to reduce emissions.

Energy-saving Efforts

AIST works to reduce energy consumption per unit to an annual average of over 1% in the medium to long term, an amount required under the Act on the Rational Use of Energy. To achieve the target, we actively install devices with high energy-saving effect when renovating facilities, in addition to taking power-conservation measures by appropriate temperature settings of air-conditioners. Our existing solar power systems are being used effectively, and renewable

energy systems have been installed in our new buildings. Presently solar power systems are installed at AIST Tsukuba, AIST Tohoku, Fukushima Renewable Energy Institute (FREA), AIST Tokyo Waterfront, AIST Kashiwa, AIST Chubu, and AIST Kansai. Wind power generation is installed at FREA.

Energy consumption per unit average of FY 2015–2019: 99.7% (98.0% compared to the previous year)

Amount of renewable energy generation: 2054 kWh (about 1% of total electricity consumption of AIST)

Green Procurement Efforts

Each year AIST discloses its policy for promoting the procurement of eco-friendly goods and services, 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 Act on Green Procurement. Moreover, automobiles were leased in a comprehensive evaluation bidding system, and the environmental threshold system was adopted for power supply and waste contracts in accordance with the Green Purchasing Act,

The procurement rate of designated procurement items defined in the Green Purchasing Act: 100% (excluding media cases)

Applying the 3R principles

AIST seeks to reduce waste by applying the 3R (Reduce, Reuse and Recycle) principles and thus to reduce environmental loads. We are focusing particularly on the reuse of research equipment, because this reuse can also contribute to cost savings. An AIST intranet-based article recycling system has been in place for items no longer necessary, including research equipment, office electrical equipment, furniture and consumables, to promote reuse within AIST.

Cases of reuse for FY 2019: 956

Response to 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. We have a communication system that once contacted can immediately deal with an accident if it occurs. After expeditious measures, related organizations are notified. The jurisdictional

department analyzes the cause of the accident and takes measures to prevent a recurrence of such an incident.

Environmental accident drills of FY 2019: 19 accident drills across all research bases (supposing damage of research wastewater pipes, leakage of research wastewater during transport)



Emergency accident drill (supposing wastewater leakage)



Environmental Education

AIST provides training prior to commencement of work to new employees 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. We provide continual education and require the employees to periodically retake the courses.



Industry–Academia–Government Collaboration and AIST

Data of Research Activities (FY 2019)

See pages 44-45 for more details▶

Research presentations
(in journals) **4,904** cases

Innovation coordinators **65** people

Research presentations
(oral) **8,656** cases

Technology consulting **690** cases

Number of joint research **1,245** cases

Technical advice **2,856** cases

Joint research revenue **7,670** million yen

Number of AIST staff
contributing in international
standardization activities **493** people

Number of
commissioned research
projects **101** cases

Number of proposed
standards **34** cases

Fund received for
commissioned research **8.6** million yen

Number of overseas
organizations with whom
AIST has concluded MOUs **27** institutes

Acceptance number of
external researchers for
joint research **2,254** people

Number of foreign
researchers **864** people

Data of Personnel Training and Use (FY 2019)

Number of users of the
cross-appointment
program **67** people

Number of students who
finished courses at AIST
Innovation School **41** people

Number of users of the
AIST Research Assistant
Program **409** people

Number of students who
finished courses at AIST
Design School **16** people

Number of technical
trainees **1,607** cases

R&D Topics

RD20 International Conference (Research and Development 20 for Clean Energy Technologies)

In October 2019, AIST hosted the first RD20 conference (an international conference for leaders from national research institutes and other organizations from G20 countries on clean energy technologies).

RD20 is an international conference for leaders of national research institutes and other organizations from G20 countries involved in the field of clean energy technologies to hold discussions in order to integrate the diverse knowledge of G20 countries, and to create discontinuous innovations that will lead to significant reduction in CO₂ emissions. At the G20 Osaka Summit, then Prime Minister ABE Shinzo made climate change a major theme of the summit. In response to his declaration that Japan should strive to be a leader in achieving a decarbonized society, it was decided that AIST, with its wide-ranging research into energy-related technologies in Japan, would host RD20.

Delegates from 23 institutes in 20 G20 attended the first RD20. The themes of the conference, which were hydrogen and CCUS (carbon capture, utilization and storage), are energy technologies that hold promise for society. The delegates shared information and exchanged views on energy policies, as well as the progress of R&D in their respective countries.

Four technical special lectures (by TANAKA Nobuo, Chair of the Innovation for Cool Earth Forum (ICEF) Steering Committee; UCHIYAMADA Takeshi, Chairman of the Board of Directors, Toyota Motor Corporation; FUJISHIMA Akira, Distinguished Professor at Tokyo University of Science; and

KITAMURA Masayoshi, Vice Chairperson of Carbon Recycling Fund Institute) and 42 poster presentations on energy technology (by organizations including Japanese corporations and AIST) were given, with over 300 people participating.

In his closing remarks, CHUBACHI Ryoji, then President of AIST and Chair of the conference, stated that, “Although G20 countries are at different stages in R&D, they are progressing in the same direction. It is important to strengthen collaboration between the institutes participating in RD20, and to build alliances to advance specific R&D in cooperation with one another.”

AIST took the opportunities gained by hosting RD20 to conclude new research cooperation agreements with six of the participating institutes.



Technology bridging

AIST conducts cooperative research, contract research, technology consulting, technical advising, contract testing, provision of research samples and so forth, and contributes to R&D and product development by businesses. At hubs such as the Cooperative Research Laboratories and Open Innovation Laboratories, AIST collaborates with companies, universities and others to investigate possible applications of technology and promotes open innovation.

Provide a Platform for Industry–Academia–Government Collaboration and Promote Acceptance of Researchers

See pages 44-45 for more details▶

● Active invitation of external researchers

Number of external researchers for joint research accepted in FY 2019: 2,254

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.

● 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 2019, 690 cases were implemented.

Deployment of Innovation Coordinators

At AIST, innovation coordinators (IC) are responsible for liaising with external bodies such as companies and universities. As of March 2020, 65 ICs strive to strengthen AIST's function of transferring technology to society. 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 improving the organization of cross-sector marketing activities spanning different domains and regional research bases. Thus, the Research and Innovation Promotion Headquarters, research domains, and research units in AIST are working together to promote collaboration with partners.

AIST supports setting up new business and creating new products and services in companies starting from coordinated menus made with various companies using its technology consulting system. Based on company-wide business plans of partners, we propose research themes that span across a number of research domains through technology consulting based on analysis of company needs using company information provided by external organizations. We also conduct “co-creation consulting” with companies to consider search of new

business seeds and setting of coordinated themes from the concept stage.

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.



Cooperative Research Laboratories

In order to conduct R&D that more closely relates to the strategies of companies, we are collaborating with partner companies and have set up Cooperative Research Laboratories in AIST bearing the names of these partner companies. The partner companies provide researchers and research funding, and AIST provides research resources including researchers, research facilities and intellectual property. The researchers loaned from the companies and AIST's researchers work on R&D in cooperation. As of July 2020, we were operating 15 Cooperative Research Laboratories. We hope they continue to make an impression as platforms for collaboration and synergy involving companies, universities and other research institutes. In FY 2019, we established the JTEKT–AIST Cooperative Research Laboratory for Smart Factory, VALQUA–AIST Cooperative Research Laboratory for Advanced Functional Materials, DIC–AIST Cooperative Research Laboratory for Sustainable Materials, and Hitachi Zosen–AIST Cooperative Research Laboratory for Sustainable Green Energy Production.

Open Innovation Laboratories

AIST has set up Open Innovation Laboratories (“OILs”), which are industry–academia–government collaborative research bases sited on university campuses. As of July 2020, ten OILs were in operation. Similarly to other bases, they seamlessly conduct basic research, application research, development and testing. They contribute to faster research and practical training of doctoral students and postdoctoral researchers through active mobility of human resources. This initiative synergizes the basic research of universities and other organizations with AIST's goal-oriented basic research and application technology development, facilitating transfers of technology to industry. In FY 2019, we established the AIST-UTokyo AI chip Design Open Innovation Laboratory (AIDL) at the University of Tokyo's Asano Campus and the AIST-University of Tsukuba Open Innovation Laboratory for Food and Medicinal Resource Engineering (FoodMed-OIL) at the University of Tsukuba.

Participation in Technology Research Associations

AIST has become a member of Technology Research Associations, the member of which jointly carry out research and development of technologies used in industry by sharing their resources such as researchers, funds, and equipment. AIST contributes to the associations' projects from planning and performing research to utilizing research outcomes.

Particularly by sharing our “personnel” and “premise”s with 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 staff members participate in the associations projects as researchers, project leaders or board members. We also give access to our facilities to researchers from industries and universities participating in the associations for carrying out intensive research.

● Technology Research Associations in which AIST participated (FY 2019)

1	Photovoltaic Power Generation Technology Research Association (PVTEC)	10	Technology Research Association of Secure IoT Edge application based on RISC-V Open architecture (TRASIO)
2	Fuel Cell Cutting-Edge Research Center Technology Research Association (FC-Cubic)	11	Technology Research Association of Magnetic Materials for High-Efficiency Motors (MagHEM)
3	Consortium for Lithium Ion Battery Technology and Evaluation Center (LIBTEC)	12	Innovative Structural Materials Association (ISMA)
4	Thermal Management Materials and Technology Research Association (TherMAT)	13	Photonics Electronics Technology Research Association (PETRA)
5	The Research Association of Automotive Internal Combustion Engines (AICE)	14	Japan Advanced Printed Electronics Technology Research Association (JAPEREA)
6	Technology Research Association for Next Generation Natural Products Chemistry	15	NMEMS Technology Research Organization Technology Research Association (NMEMS)
7	Manufacturing Technology Association of Biologics (MAB)	16	Technology Research Association for Future Additive Manufacturing (TRAFAM)
8	Control System Security Center (CSSC)	17	Geological Carbon dioxide Storage Technology Research Association (CCS)
9	International Research Institute for Nuclear Decommissioning (IRID)	18	International Standard Innovation Technology Research Association (IS-INOTEK)

TIA Collaborative Research Program (“Kakehashi”)

“Kakehashi” (a Japanese word for a “linking bridge”) is a program that promotes collaboration among the six organizations of TIA (AIST, National Institute for Materials Science, University of Tsukuba, High Energy Accelerator Research Organization, the University of Tokyo, and Tohoku University (Tohoku University joined on April 1, 2020)). Since it started in FY 2016, “Kakehashi” has been supporting feasibility studies with the aims of finding “seeds” and “sprouts” of research and technology at various stages, nurturing “buds” through collaboration and transferring “fruits” to industry. It has helped advance development of technologies related to semiconductor manufacturing systems and wearable healthcare sensors.

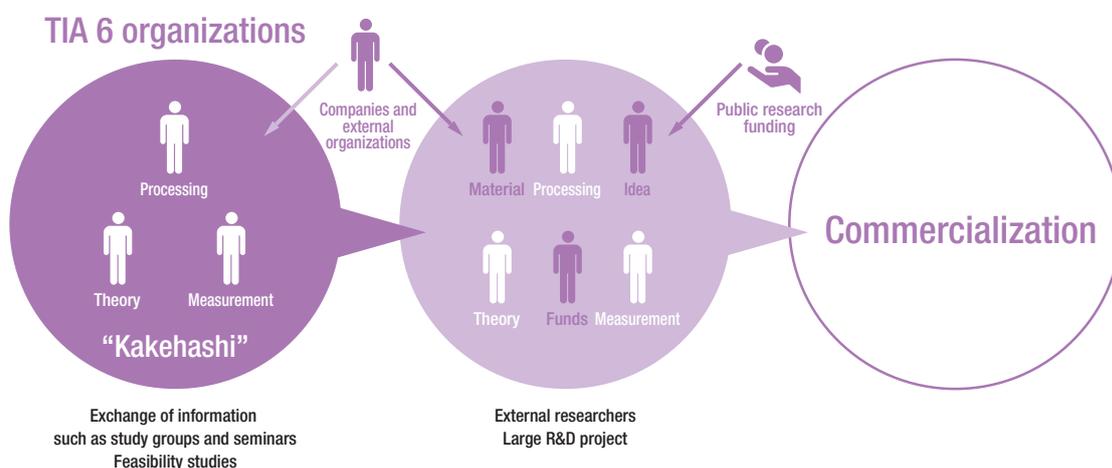
● Activities in FY 2019

The 52 “Kakehashi” feasibility studies in FY 2019 covered biotechnology and computational materials science, as well as numerous fields covering interdisciplinary areas. We provide not only financial support but also hold many workshops and symposia on issues related to various stages in research development.

● Company-proposed themes

We started implementation of “Kakehashi” themes proposed by companies with TIA mediating to organize “Kakehashi” teams in FY 2018. In FY 2019, 4 cases were implemented.

● Image of “Kakehashi”



Promoting International Standardization

See page 44 for more details ►

AIST is engaged in standardization activities, utilizing its R&D achievements. 57 AIST researchers are actively serving as chairs, committee managers, or convenors while 436 are participating as experts with specialized knowledge contributing to the development of standards.

In FY 2019, we proposed a total of 34 domestic and international standards, including the Japanese Industrial Standards (JIS) for the safety management of robotic services, and ISO standards for the chromatographic measurement method of hazardous chemical substances in environmental water.

AIST has held a Symposium on Strategies for the International Standardization each year since FY 2011, to enhance standardization efforts by sharing the importance and challenges of standardization and certification with relevant parties in industry and government. In FY 2019, AIST cohosted this symposium with the New Energy and Industrial

Technology Development Organization (NEDO) and the National Institute of Technology and Evaluation (NITE) under the theme of “International Standards Solving for Marine Plastic Litter Pollution.”

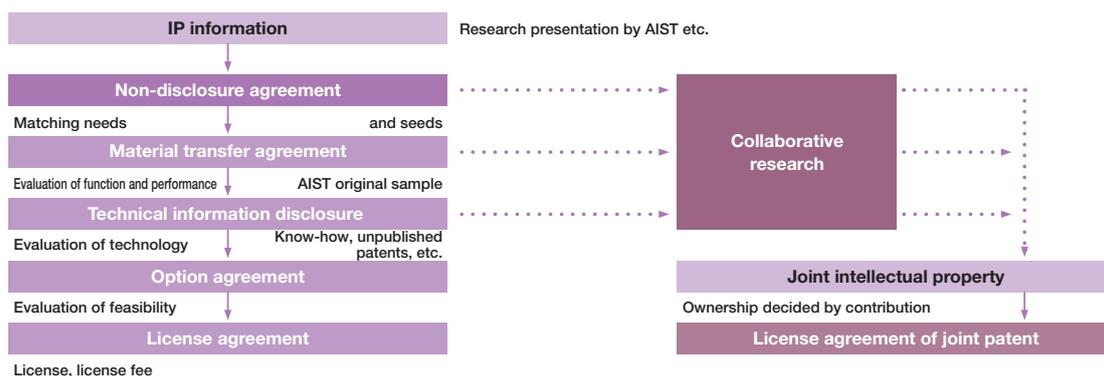
In FY 2020, in addition to the activities thus far, AIST plans to establish a “Standardization Promotion Center” undertaking a leading role of standardization necessary for society by utilizing the research potential of AIST for issues concerning standardization received from external organizations and enterprises.

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.

Specifically, based on the needs of the partner in cooperation for AIST's intellectual property, we perform the necessary procedures (signing of a non-disclosure agreement, a material transfer agreement, a technical information disclosure agreement, a license agreement and such), and promote wide dissemination of AIST's research outcomes in society.

● Technology transfer process



Deploying and developing human resources

AIST promotes staff exchanges to facilitate the development and utilization of personnel who will produce innovation. AIST's efforts to develop training activities include AIST Innovation School and AIST Design School.

Cross-appointment Program

See page 44 for more details ►

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 multiple institutions and he/she can work in research, development, and education according to one's role in each institution.

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.

We accept 41 researchers from 16 universities, 1 private company, and 1 institution, and send 10 researchers to 5 universities and 1 private company, and 2 institutions. (As of April 1, 2020).

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 2019, 409 students in graduate programs engaged in R&D at AIST.

● Employment requirements for AIST Research Assistants

(as of May 2020)

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 graduate students employed in FY 2019	409	

Voices of research assistants

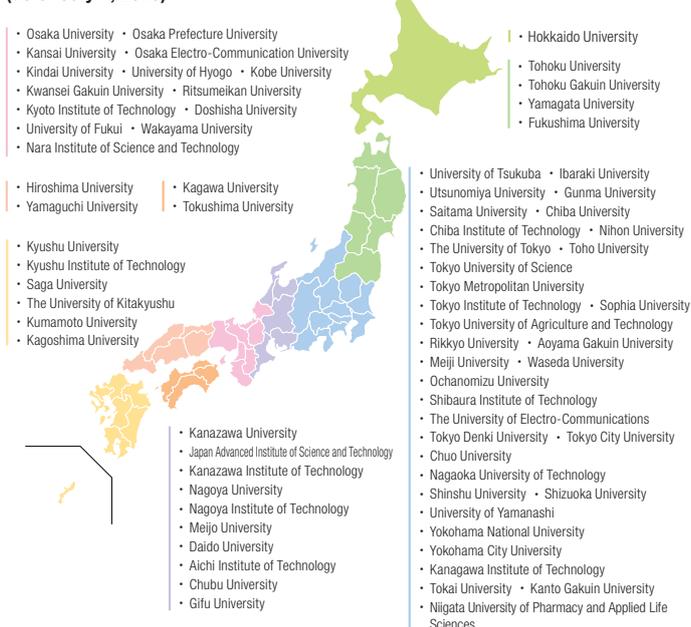
The best part of being an RA is that you can interact on a daily basis with researchers and students of different fields whom you would not meet at university. (Third-year student of doctoral program)
 Research at AIST is high-level, and I am learning new research approaches daily. (Second-year student of master's program)

Technical Training

See page 45 for more details ▶

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.

● 74 Universities with partner graduate school agreements (as of July 1, 2020)



● Partner Graduate School Program

Using the knowledge and experience gained at AIST, AIST researchers teach as guest professors at graduate schools that have cooperation agreements with AIST. Within this program, AIST also provides technical training to the graduate students on the site of AIST. This program is deemed to be part of the students' academic degree programs.

Innovation School

AIST Innovation School aims to train human resources able 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 postdoctoral researchers and graduate students, and provides lectures and training to learn and develop 3 skills: “research skills” that are learned through scientific and technological knowledge in specific areas of expertise, “cooperation skills” acquired through working with experts in different fields, and “resourcefulness” nurtured through communication, the ability to think, and develop one’s own career.

In FY 2019, we conducted lectures, seminars, and long-term business training as part of the training

course of “human resources for innovation”, and 13 postdoctoral researchers completed the course. We ran a half-year course on “basic research skills” as education programs for graduate students, and 28 students completed the program of lectures, seminars, and technical training.



● Curriculum of the Innovation School

1 Lectures and exercise at AIST

- Lectures on philosophy and research management and on postdoctoral human resources expected by companies
- Lectures on intellectual property, research ethics, companies and industries
- Lectures on research cases (of AIST, other national research institutes), how to create an innovative project, how to write papers
- Exercise on skills in presenting research in ways that can be understood by people from different fields
- Acquisition of business manners, communication skills, how to develop one's career, ability to think

2 Research at AIST

- Working on research topics in laboratories
- Experiencing research at AIST

3 On-the-job training with companies

- (about 2 months on average, part of the training course of “human resources for innovation”)
- Research development activities, productization, speed of technology development, importance of cost awareness at companies
 - Experiencing teamwork, importance of collaboration with other departments

● Expanding the vision of 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 school was really helpful in deciding my course of life.” They realize from experience that there are a variety of opportunities to work as researchers; to broaden their horizons as “It gave me a good opportunity to reexamine the area and industry that needs my skills,” or “It made me realize you need the ability to collect and comprehend widely across different areas,” and to change their awareness. Companies that have accepted trainees say that “The students made us aware of new perspectives and inspired our employees,” or “We gained valuable technological knowledge from the students.” The companies rate the trainees' research capabilities and work attitudes highly.

Since the school started, 320 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.

AIST Design School

This is said to be the age of VUCA (volatility, uncertainty, complexity and ambiguity), an age of rapid change in which it is unclear what things should be created and what issues should be addressed with R&D. In particular, there has been a huge change in lifestyles since the beginning of 2020 because of the COVID-19 pandemic. Meanwhile, technologies such as AI and robotics have the potential to progress at speeds beyond the capacity of humans to adapt to change.

In these times, processes leading to social applications of new technologies require great changes from the conventional: conception from original ideas, research and development, field testing outside the laboratory such as in local districts and dedicated facilities, and returning technologies to society through mass production and commercialization. At the same time, researchers and other people must be flexible in thought and not shackled by previous successes, must have the space and time to improve their capacity to adapt to rapid change, and must possess and fully exploit the imagination to create a new society.

To meet these needs, we opened AIST Design School in FY 2018 as a forum for AIST researchers and participants from business to cultivate four skills: insight skill, foresight skill, co-creation skill and phronesis*. “Insight skill” means to understand and shape one's will in envisioning the future. “Foresight skill” means to look beyond one's discipline to envision an ideal future. “Co-creation” means creating new values through discussions with others on visions of

the future. “Phronesis” means social application of thoughts and ideas from these series of discussions.

In FY 2019, we concluded a collaboration agreement with KAOSPILOT, which is considered the most radical business school in Denmark, and drew up a personnel development curriculum. AIST Design School offers creative leadership training; teaching on future insight by a professor from Hitotsubashi University; and teaching on design thinking, systems thinking and workshop design by a professor from the University of Tokyo who taught for years at Britain's Royal College of Art (the RCA). The AIST Design School is providing next-generation leadership development activities while giving thought to societal problems that affect residents, high school students and other people in the neighborhood of AIST Kashiwa.

In FY 2020, the school was planning with its students to start new learning in July, generally to be conducted remotely.

* Phronesis is a Greek word meaning “practical wisdom,” used in Greek philosophy by Aristotle and others.



A scene from a workshop at KAOSPILOT

Strengthening international collaboration

AIST is building a global network with prominent research institutes around the world, and is promoting efficient and effective research cooperation through international collaborative research, workshops and seminars, and personnel exchanges which include dispatching and inviting researchers.

Increasing Global Presence

AIST has been increasing its global presence not only by conducting world-leading research, but also by strengthening collaboration and through interorganizational personnel exchanges with overseas research institutes. In an effort to enhance collaborative relations with overseas institutes, AIST, together with RIKEN, organized the Eighth Global Summit of Research Institute Leaders in October, 2019. The purpose of this summit is to bring together the heads of the world's leading research institutions to discuss the future of science and technology, the role of each institute, and collaboration among research institutes. The eighth summit was attended by leaders representing 23 world-renowned research institutes from 12 countries, who engaged in vigorous discussion on the theme, "Exploring Avenues for Multilateral Cooperation: Instruments and Mechanisms." AIST was represented by then President CHUBACHI Ryoji, who in his opening remarks spoke of the importance for each

country's national research institutes to work together and lead innovation in order to realize a sustainable society.



The 8th Global Summit of Research Institute Leaders

Strengthening International Collaboration to Address Global Issues

AIST, has concluded comprehensive Memoranda of Understanding (MOUs) with 27 leading institutes which represent various countries/regions worldwide, and is building an international network with the aim of solving global issues. In accordance with these MOUs, we have conducted joint research and personnel exchanges with overseas institutes. In June 2019, we hosted a workshop with the National Research Council Canada (NRC), in which ideas were exchanged on a wide range of topics related to electronics and manufacturing, IoT, materials science, environment and energy. Through this exchange, many common research topics were identified in research domains of both organizations, and thus, an MOU was concluded in October of the same year.

The following November, we held a joint symposium with the Industrial Technology Research Institute of Taiwan (ITRI). Since we concluded an MOU in 2005, we have held seven joint symposiums with ITRI (as of March, 2020). This particular symposium was especially

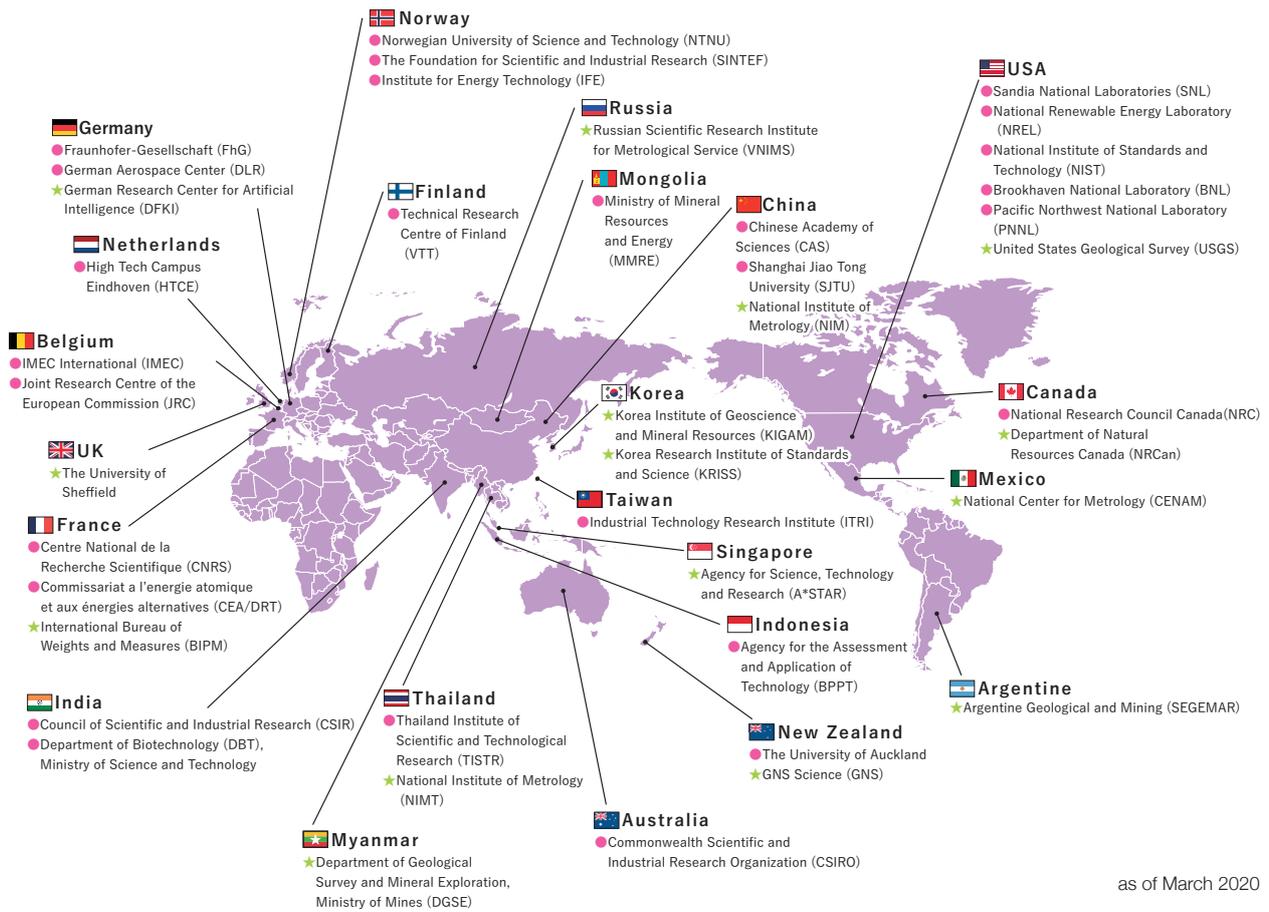
fruitful, with exchange of opinions on a new topic of research management, and there were discussions not only on technological issues, but also on practical applications.



Workshop of NRC and AIST

LIST of MOUs

● : Comprehensive MOUs ★ : Specific MOUs (excerpts)



as of March 2020

Accepting Foreign Researchers

See page 45 for more details ▶

To enhance cooperation with overseas research institutions and to develop an international network of researchers, AIST actively accepts researchers from universities and research institutions outside Japan. In FY 2019, a total of 864 foreign researchers engaged in research at AIST.

In terms of regional statistics, researchers from Asia accounted for more than 70% of the total, followed by

Europe. The Department of Information Technology and Human Factors accepted the most number of researchers (approx. 30.1%), followed by the Department of Materials and Chemistry (approx. 19.7%), and the Department of Energy and Environment (17.0%). We will continue to promote close collaboration with overseas research institutions through personnel exchange.



AIST and it's staff

Human rights

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

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 2019, we implemented 35 new and 177 ongoing research projects involving ergonomic experiments; 15 new and 85 ongoing research projects involving experiments with human derivative samples; and two 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 five 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 (renamed the Conflict-of-Interest Management Committee for Medical and Health Research Involving Human Subjects in July 2019) in place, which examines solely conflicts of interest in medical research. This committee reviewed five cases in FY 2019.

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

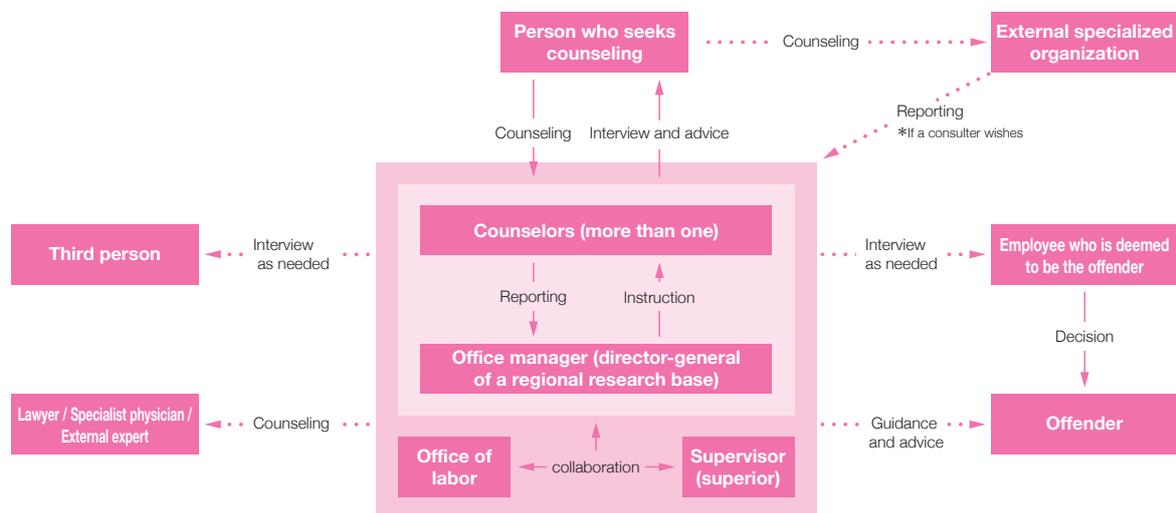
Each site has workplace harassment counselors. The counselors work to counsel, investigate, and mediate so that harassment victims are not distressed and suffer alone as a result of their experience. If the line of management or a counselor cannot address a harassment issue, it is possible to file for the recovery from the disadvantages suffered. In this case, the Compliance Promotion 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 2019

Training program	Trainees	Objectives	Number of trainees in FY 2019
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.	110
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.	5,686
e-learning training (English)	Foreign researchers and contract employees who have difficulty in understanding Japanese	Same contents as e-learning training (in English)	177
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.	59
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.	383

● 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.

Hiring Fixed-term Employees through Open Recruitment at AIST

The work conducted by AIST's headquarters organizations and operating units 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 contract employee 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 45 people in total, and these employees have been working at the headquarters organizations and operating units. We receive dozens of applications each year, and in FY 2020, we hired three persons.

The employees can work for up to 2 years, yet they have a chance to be hired as a permanent employee based on evaluations of their work performance. 3 employees have been rehired as permanent employees. AIST will continue to hire fixed-term regional employees to support research and development, innovation, and other activities.

Diversity

Diversity and utilizing a diverse workforce are essential to pursuing creative research and building energetic workplaces. AIST aims to provide a working environment that embraces the values and ideas of employees with diverse attributes, including gender, age and nationality.

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 13 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, clean and recycle binders, and do cleaning, among other tasks. In 2019, ten days before the AIST Tsukuba Open House event, they bagged questionnaires and pamphlets to be handed out to visitors. The team will try new tasks and hopes to utilize its ability.



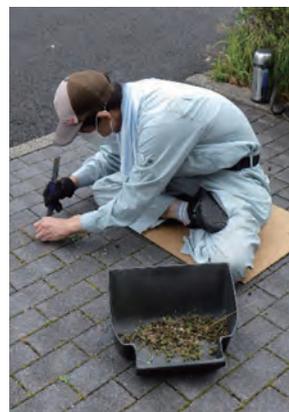
Preparing bags to be distributed to visitors of Open House



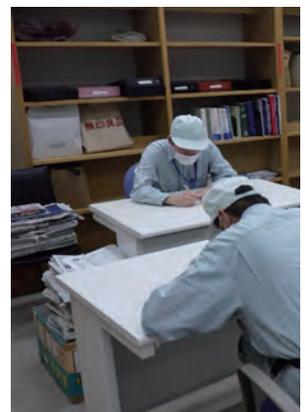
Bagging questionnaires for visitors of Open House

● AIST Chubu

The AIST Chubu Challenged Team currently has five members and one instructor. The team's tasks include cleaning and weeding the premises outdoors, activities indoors such as sorting paperwork, cleaning meeting rooms, collecting, sorting, and recycling of used paper, transporting copy paper, and helping bind copies of AIST Chubu's public relations magazine, with social distance awareness. The team also rearranges furniture in preparation for events. The team intends to be active in various other areas.



Weeding



Sorting paperwork

● AIST Kansai

The AIST Kansai Challenged Team presently comprises one member and one instructor, assisting clerical work and working to beautify the premises. It contributes to maintaining trees and vegetation there by clearing weeds with a weeder, cutting high dead branches with a tree trimmer, and doing other tasks by hand or using various machinery and tools. When it rains, the member chiefly cleans the windows, mops the floors, and shreds discarded documents, in the buildings. In addition, upon request from departments of AIST Kansai, the member helps out with various other tasks.



Checking weeding sites



Clearing weeds with a weeder

Prayer Room at AIST Tokyo Waterfront

As we recruit increasing numbers of foreign researchers, we are striving to provide a pleasant work environment with consideration for employees of diverse nationalities, cultures, and religions. In December 2019, we opened a prayer room at AIST Tokyo Waterfront for employees working at AIST and other people who require prayer and meditation for reasons of faith. The room is open from 9:30 AM to 6:15 PM on weekdays and can be used whenever it is not occupied.



Measures to promote diversity in the Fourth Medium- to Long-term Plan

See pages 46–47 for more details▶

Measures to promote diversity in the Fourth Medium- to Long-term Plan (October 2015 to March 2020) were stipulated in October 2015. Activities in FY 2019 are shown in the table below.

Measure	Goal	Main outcomes in FY2019
Proactively hiring female researchers and supporting their advancement	At least 18% of researchers hired from FY 2015 to FY 2019 to be female	We reached the goal, with 18.8% at the end of March 2020.
	Proactive PR activities to recruit female researchers	We held an event for female students at AIST Tsukuba, bringing 31 university students from around the country. At open house days, we have provided venues for female students from middle school to postgrad level to gather and we presented them with role models. We have cooperated on local events, exhibited with other R&D companies and participated in lunch seminars at academic societies, and held activities at universities and career information events in various regions. These activities have drawn 327 participants.
	Women to be at least 5% of managers by the end of FY 2019	The proportion of female managers was 6.1% at the end of March 2020.
Supporting foreign researchers in their recruitment and work	To provide information and PR activities to support the recruitment and integration of excellent foreign researchers	We have publicized AIST widely, exhibited with other R&D companies at international conferences with many foreign participants and in joint presentations with companies at the University of Tsukuba, Nara Institute of Science and Technology, and Nara Women's University.
	To expand the services of AIST International Center (AIC)	<ul style="list-style-type: none"> AIC collaborated with relevant departments to give foreign researchers seminars in English about the Institute's rules and programs Japanese lessons; information for foreign staff (a monthly newsletter) 228 consultations on various subjects and 32 enquiries about the Ministry of Justice's points-based preferential immigration system for highly-skilled foreign professionals
	To create a comprehensive multi-language support system for management tasks	Relevant departments collaborated to create and update manuals and to provide intranet resources for management and computer systems that foreign group leaders and the like frequently use, as well as the usual internal duties.
Achieving Work-life Balance	To enact measures to support work-life balance and measures according to the law on encouraging the taking of annual paid leave	<ul style="list-style-type: none"> Individual interviews to provide support for employees returning from childcare leave Distribution of leaflets explaining the nursing care support system A seminar at Tsukuba explaining childcare and nursing care systems, streamed live to regional research bases Work-life balance seminars and lunch meetings; a touring salon and training sessions at regional research bases
	To improve the childcare support system as necessary to meet the needs of employees during maternity leave, during childcare leave, and after returning to work	We created a system for supplementary staff support for researchers with restricted working hours due to childcare or nursing care, supporting 13 employees (11 for childcare and two for nursing care).
	With the aim of improving support in order to moderate career interruptions due to life events, a trial introduction and study of working from home	We provided a teleworking system, which has been used by 26 employees (9 men and 17 women).
Career development	Initiatives to conduct on-the-job training and study training so that diverse AIST employees can develop flexible careers regardless of age, sex and nationality	<ul style="list-style-type: none"> On-the-job training Lectures on diversity in internal training (induction training and unit manager training)
	To provide career counseling and training from experts, a mentor system, and consistent support from career path design to career development	<ul style="list-style-type: none"> Career advancement support training (two sessions, totaling 31 participants) A mentor system for young administrative staff Career counseling from experts, and experience counseling in regional research bases at AIST Hokkaido and AIST Chugoku
Comprehensive promotion of diversity	To create suitable working environments for people with disabilities, provide support for people with disabilities in cooperation with Support Centers, promote hiring of people with disabilities and comply with statutory employment rates, and support people with disabilities to be active members of society	<ul style="list-style-type: none"> The rate of employees with disabilities was 2.6% on June 1, 2020, achieving the statutory rate (2.5%) The retention rate is high (91.9% in FY 2019) Preparation of suitable working environments, including installing anti-slip surfaces in parking areas and handrails to assist mobility in toilets
	Guided by the Diversity Promotion Committee, to apply the PDCA cycle to promotion measures, consider necessary policies, and build awareness of diversity	We have consolidated a continuing policy of funding subsidies for the employment of helpers. We identified ten employees to be supported with childcare or nursing care in FY 2020 (as of the end of March 2020).
	To contribute to the Diversity Support Office as a key member organization and sustain cooperation with other organizations	We adopted MEXT's FY 2016 development support program for science personnel, "Initiative for realizing diverse research environments (collaboration type)." Together with the University of Tsukuba and IBM Japan, we worked on activities to promote the "action plan on the act to promote women's participation."

Safety and health

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 creates a work environment in which all people working here can do so in a safe and healthy manner.

Occupational Health and Safety

See page 48 for more details▶

● 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 safety and health 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 2019 revisions include the following:

- 1 Following the revisions of the Act on Rational Use and Proper Management of Fluorocarbons, a section was added on the retention period and the discarding method of the inspection log.
- 2 To enhance the management system of poisonous and deleterious substances to prevent harmful incidences, a section was added concerning the record retention period and the inspection recording method of poisonous and deleterious substances.
- 3 For appropriate execution of experiments using unmanned aircraft, a section was added concerning precautions for use.

● 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.

● 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 14 research bases across the country through a teleconferencing system to exchange information on accidents, near-miss incidents, health issues, and information security at Tokyo Headquarters, the regional research bases, AIST Tsukuba, and other sites. The aim is to share details of recurrence prevention measures and thus improve safety and health.

FY 2019 saw a decrease in the number of total cases including accidental falls compared to FY 2018. However, there were still the same number of accidents resulting in injuries. To address this situation, we provide safety education to make sure that proper protective equipment is worn, prepare work procedure manuals and risk assessment for high-risk tasks, and enhance sensibility by conducting risk prediction activities to foster safety culture.

● **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 as needed. To use institute vehicles, it is compulsory to take courses on safe driving according to regulations for work vehicle management, and safe driving is promoted. 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, and for those handling high-pressure gas to take high-pressure gas safety courses or to obtain a License for Manager for High-pressure Gas Safety. 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.

Health Management and Mental Health

See pages 48–49 for more details ▶

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.

● **Outline of return to work program**



*Depending on the length etc. of absence from work

Column COVID-19 Measures

AIST has set up a COVID-19 prevention measures HQ with President Ishimura as Director. We are performing research activities after taking comprehensive infection prevention measures. In addition to research relating to the COVID-19, we are pursuing initiatives to address the societal problems.

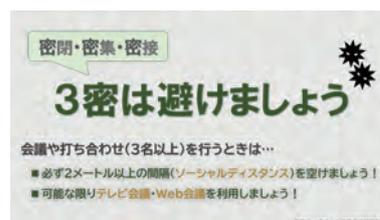
1. Measures to prevent infection

We have put in place a range of infection prevention measures such as encouraging people to avoid the “Three Cs” and maintain social distancing, frequently exchanging the air in indoor spaces, and taking internal meetings online. In addition, we are using digital signage and posters to promote hand washing and cough etiquette such as wearing masks.

We have adjusted the working arrangements of employees as appropriate in response to the policies and requests of the national and local governments. For example, by encouraging teleworking (working from home), we reduced the number of employees in workplaces during the state of emergency by 80%. For employees with long commutes who face high infection risks traveling to and from work, we have approved satellite working at alternative sites. For employees who use public transport, we are deploying working arrangements such as flextime and discretionary working, and we

are encouraging them to avoid commuting in rush hours.

In general, unnecessary or nonurgent trips and events are being cancelled or postponed. Where events can be held online or streamed, we are acting to modify how those events are held. With consideration for the societal situation, AIST will take appropriate infection prevention measures that will be continued in our day-to-day activities.



An example of a display on digital signage

2. Research activities

AIST is pursuing cutting-edge R&D into the COVID-19 and is collaborating with other organizations. A novel PCR technology developed by AIST is used in a compact, rapid gene detection and quantification device (GeneSoC) that is currently being deployed in medical facilities in Japan. We are also conducting many other research activities, such as providing free access to the AI Bridging Cloud Infrastructure (ABCI) for work on COVID-19.

In addition to our research activities, we have upgraded our portal website, “AIST Science Town,” so that people can study at home while schools are closed because of the pandemic. The website provides videos of science events

that explain cutting-edge science simply, such as videos of construction projects and robots. The site presents materials that can be enjoyed by all generations from children to adults.



The AIST Science Town website

3. Other contributions

To support clinical and nursing care venues lacking in medical resources, we are providing medical resources that are not needed for urgent research purposes to Ibaraki Prefecture free of charge.



Community Involvement

Opening our facilities to local people: AIST Kashiwa Open House

AIST Kashiwa is our newest research base, opening in November 2018. It is pursuing research centered on human augmentation technologies that are put in close proximity with people to enhance their human capabilities. These technologies can improve the quality of people's lives. By making use of information technology and robotics technology, which can be worn on people's bodies and support their movements, personal capabilities can be enhanced and maintained. Our concept was to link these technologies to social applications in the fields of medical care, work and nursing care, at first in the Kashiwanoha area of Kashiwa, Chiba Prefecture, where AIST Kashiwa is located.

In order to interest local residents in the research activities of AIST Kashiwa and win their cooperation, we opened up our research facilities to the public for the first time on November 3, 2019 in "AIST Kashiwa Open House."

In this open house, we hoped to interact with local people in a wide range of age groups and to acquaint them with the concept of human augmentation. We made the theme of the day ninjas, who can easily be understood as humans with enhanced capabilities. We provided numerous hands-on attractions that even children could try for themselves. We devised ways to inspire interest in human augmentation technologies and field testing in the town. On the day, over 1100

people visited, mainly families but also junior and senior high school students, older people, and visitors from companies.

Getting a range of opinions from people living in the area is very important for us to learn about societal problems in the area. Therefore, we solicited opinions with a project called "the town trees," to which visitors stuck notes describing issues in the area, and we asked for cooperation with a resident participation council as "citizen advisers."

AIST Kashiwa aims to leverage this creative cooperation with the local community to create new services built around human augmentation technologies.



A flyer for the open house



Being a ninja



The town trees

The TAI Project: Help for regional businesses planning to create new ventures

AIST Tohoku started new support measures for regional businesses in 2018, naming them the Tohoku Advanced Innovation (TAI) Project.

This is an attempt to create new ventures in the Tohoku region by an “ensemble” of industry, academia, government and finance including, in addition to AIST Tohoku, the Tohoku Bureau of Economy, Trade and Industry and public research organizations in each prefecture.

There are questions as to what specific initiatives are required to create new ventures. The environment in which small and medium enterprises operate is now changing fast. Many managers feel confused and worried as to how to introduce cutting-edge technologies into their businesses and how to deploy these technologies as mainstays to grow new ventures.

Accordingly, the first initiative of the TAI Project was to provide a venue for all managers to study these questions together, by hosting study groups for them to gain new insights and pointers. These study groups, under the title “Expanding Business Innovation for executiveS (EBIS) workshops,” are different in many respects from previous workshops. Firstly, because numbers are kept small, discussions can be free and easy. The participants are not one-sidedly lectured, as the focus is on deeper conversations among instructors and participants. Secondly, the participants can propose topics for discussion in the workshops; also, opportunities are provided to actually try cutting-edge technologies.

In FY 2018, a total of eight EBIS workshops were held in three prefectures: Aomori, Iwate and Miyagi. In

FY 2019, 20 were held in all six of the Tohoku prefectures. A total of 628 people (114 of them business owners and managers) took part. The workshops covered a wide range of topics, including energy, IoT, and materials, according to the situations and needs of the different prefectures. All the workshops generated lively discussions with intensive study. Practical outcomes so far are slight but new buds are appearing, with workshop participants investigating the use of IoT for inventory control, making applications to various support systems, and so forth.

Through the TAI project, AIST Tohoku is continuing to actively support regional enterprises so that all managers of small and medium enterprises can gain new insights, more businesses are motivated to create new ventures, and industry in the region is invigorated.

Participant comments

- **I want to use this to enter different sectors, which has been an issue for some time.**
- **It reconfirmed the importance of preparing for technological innovations.**
- **Now I can identify the latest trends in the industry, which seem to be both threats and opportunities.**

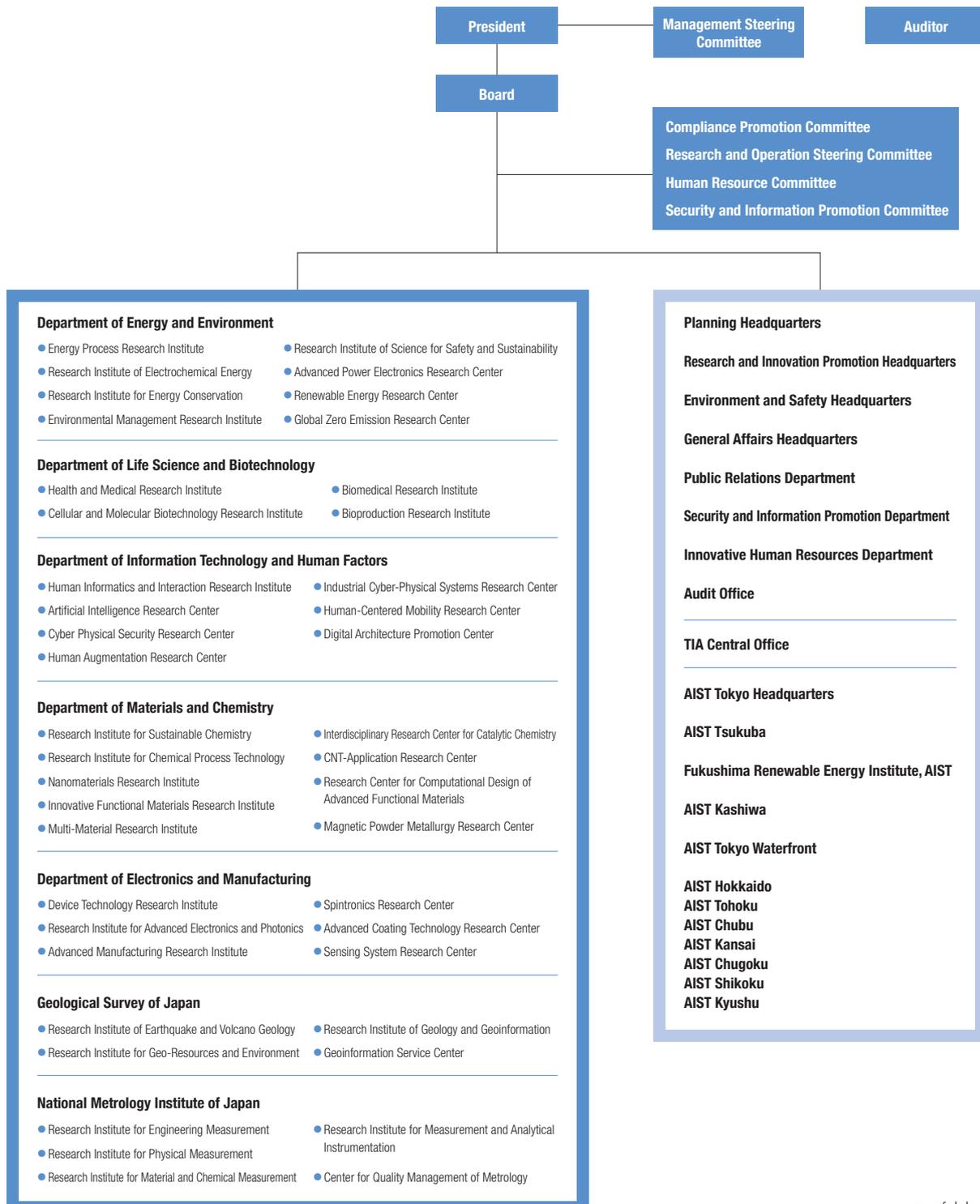




Basic Information about AIST

Organization Profile

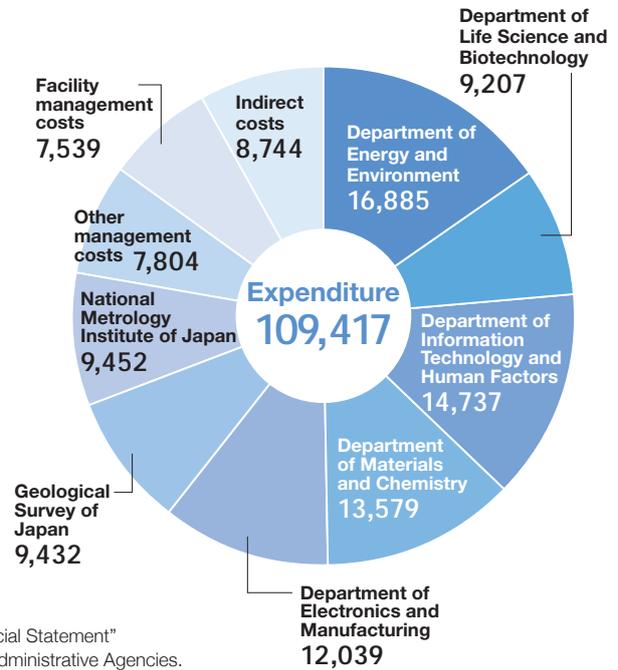
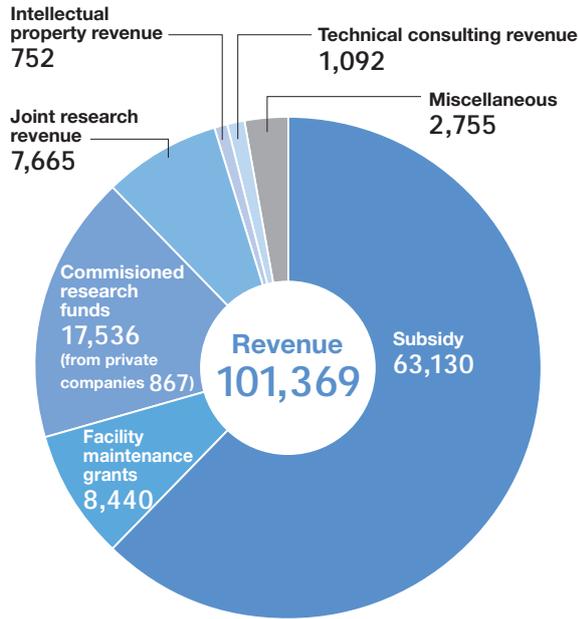
Organization Chart



as of July 2020

Revenue and Expenditure

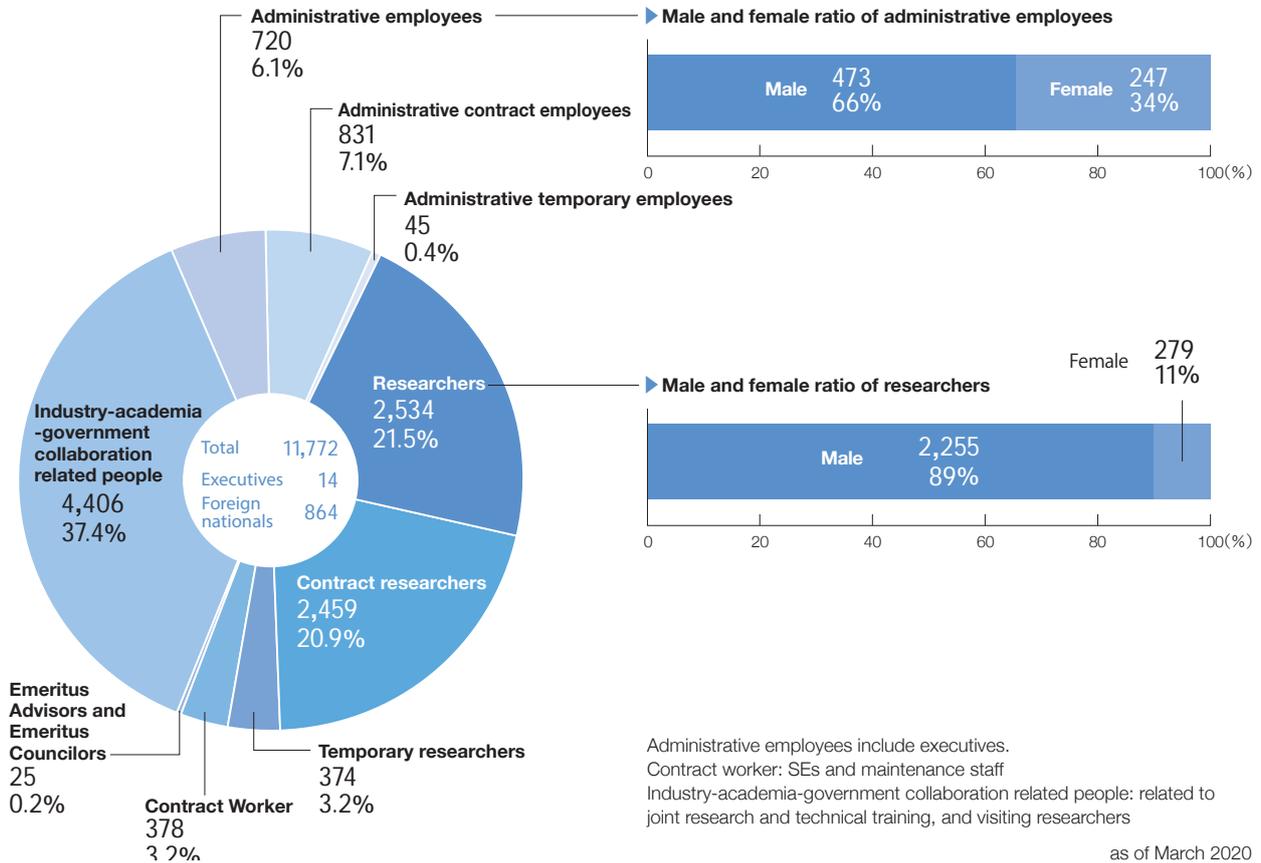
Financial results for FY 2019 (unit: million yen)



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



Future Outlook

Under the banner "bringing technology to society," AIST is pursuing research activities to give the world technologies that can enable a sustainable society, address societal problems, and generate economic development.

Review of the Fourth Medium- to Long-term Plan

1. The goals of the Fourth Plan

Previously, Japanese companies became world leaders by manufacturing and selling products with world-beating quality. In recent years, however, it has become harder for large companies to themselves deal with everything from basic research to R&D and commercialization. Meanwhile, there are many excellent technological seeds that Japan has not managed to commercialize. Producing the innovation that leads to rapid commercialization of technological seeds and improving the function of "bridging" between varied organizations such as companies and research institutes are vital elements that determine the competitive strength of Japan's industries.

Recognizing this, AIST identified playing a role as a bridge linking innovative technological seeds to commercialization as the most important management issue for the five years of the Fourth Plan and proposed, as a specific objective, to at least triple contract research income from private businesses and the like over the five years. In addition, as an institute with

responsibility for geology and measurement standards, AIST took on important missions to meet the needs of diverse users: working to maintain and improve intellectual infrastructure in accordance with the government's Intellectual Infrastructure Development Plan; recruiting, training, and flexibly deploying research personnel; and nurturing personnel who will contribute to improved technology management.

As we entered the second year of the Fourth Plan, AIST was newly designated as a Designated National Research and Development Agency. Among Japan's National Research and Development Agencies, this Institute faces particular expectations in roles such as producing outcomes from R&D at world-leading standards; guiding the creation of venues where people, knowledge and funding from industry, academia, and government can come together; and creating trail-blazing initiatives to promote innovation in science and technology. These were also taken on as missions in the Fourth Plan.

2. Major results of the Fourth Plan

We created and operated various systems and schemes to improve the bridging function identified as the most serious management issue of the Fourth Plan. Representative examples include the Cooperative Research Laboratories, which are laboratories sited in AIST for collaboration with companies that show a strong commitment to commercialization of research outcomes; the Open Innovation Laboratories (OILs), which are industry-academia-government collaborative research bases sited on university campuses; and a technology consulting system that supports launches of new ventures by business and the creation of new products and services. Through these initiatives, we have not just expanded the scale of collaborations between AIST and companies and universities but also greatly changed the quality of collaborations, creating a virtuous circle in which one collaboration leads to a variety of subsequent collaborations. We have also expanded the system of Innovation Coordinators (ICs), who link the needs of the industrial world with seeds from AIST; we now have around 200 ICs. Although improving the bridging function has not enabled us to achieve the original target for increasing contract research income from private business, the value has more than doubled in the five years, setting a high

benchmark has produced definite results.

In research, we have produced a range of successes from basic research to demonstration research for social implementations. For example, at the Fukushima Renewable Energy Institute, AIST (FREIA), we are the first in Japan to synthesize ammonia from hydrogen produced with renewable energy, and the first in the world to generate electricity by direct combustion of ammonia. Because carbon dioxide is not emitted when ammonia combusts, there are hopes that carbon dioxide emissions can be substantially reduced by switching to ammonia from conventional electricity generation fuels. These successes are a major step toward the practical use of ammonia for power generation.

AI technology has very rapidly drawn society's attention; expectations are high. We have accelerated projects for social implementations of AI technologies, such as building the AI Bridging Cloud Infrastructure (ABCI, one of the world's powerful supercomputers) on the University of Tokyo Kashiwa II Campus, to be a global research base for AI, and building a new laboratory building at AIST Tokyo Waterfront. ABCI can be used for virtual environments for data gathering and testing and for industry-academia-government

cooperative research. ABCI is an energy-efficient open infrastructure built and run by AIST; it has global top-class arithmetic processing performance and data processing performance. Research using ABCI has produced research successes that are only possible now thanks to the great computing power of ABCI, which has set a new world speed record for deep learning.

In research relating to intellectual infrastructure development, we had remarkable success in greatly contributing to the first revision in 130 years of the definition of the kilogram. We have already started providing standards based on the new definition.

In personnel development, we have been running AIST Innovation School since the Second Plan,

accepting AIST young researchers with doctorates and graduate students, where they can deepen their knowledge of their expert fields and develop their capacity to cooperate with experts in other fields. During the Fourth Plan, a total of 229 completed the training.

We also launched AIST Design School for researchers and engineers from business, to develop co-creative technology leaders who can explore what society needs and cooperate to create lifestyles of the future.

We have expanded the AIST Research Assistant Program that hires and pays salaries to graduate students with R&D ability. We now have over 300 students a year conducting research in AIST.

3. Looking ahead to the Fifth Plan

The improvement of the bridging function that we worked at in the Fourth Plan is an important responsibility for AIST, but the specific goal of at least tripling the amount earned from private funding was a tough challenge. While the initiatives of the Fourth Plan have strengthened the infrastructure of collaboration with organizations outside AIST, outcomes prompted by an organizational governance that is particularly sensitive to achieving goals have produced circumstances in which it is difficult to properly fulfil the role of a National Research and

Development Agency in providing balanced responses to the various requirements of the nation and society.

Therefore, missions for AIST in the Fifth Plan are to produce world-beating innovation, solving societal problems, and contributing to stronger economic growth and industrial competitiveness, and to aim to be one of the world's top research institutes, continuing to improve the bridging for which AIST is responsible and making use of our collective strength to respond to the needs of the nation and society.

Policies of the Fifth Medium- to Long-term Plan

Introduction

Looking at the world today, we see a major revolution with the digital transformation spreading through all aspects of society thanks to technological developments and social implementations of the Internet of Things (IoT), big data, AI, and so forth. It is becoming possible to produce previously unseen new values and services that can link all people and things and share many kinds of knowledge and information; diverse new business models are appearing. Meanwhile, Japan is facing various societal problems such as energy and environmental constraints*, an

aging and shrinking population, disaster prevention, and now COVID-19. Solutions to these problems are strongly needed. AIST commenced the Fifth Plan in April 2020 with a view to addressing societal problems.

*: In Japan in particular, energy resources are subject to constraints on supply for various reasons. There are also constraints on energy use relating to the global environment, such as climate change and environmental pollution. These are collectively referred to as "energy and environmental constraints."

Basic policy for the Fifth Medium- to Long-term Plan

In the Fifth Plan, AIST has taken up the mission of producing world-beating innovation that solves societal problems and contributes to stronger economic growth and industrial competitiveness. We will make particular efforts focused on the following three themes.

- 1 R&D that spearheads innovation for solutions to societal problems**
- 2 Strengthening the innovation ecosystem through improved bridging**
- 3 Developing infrastructure to support the innovation ecosystem**

To maximize the outcomes of these efforts, we are working on pioneering laboratory management as a National Research and Development Agency, enhancing and accumulating technological intelligence, and contributing to national strategies.

1. R&D that spearheads innovation for solutions to societal problems

● Promoting strategic R&D that contributes to solving societal problems

AIST is expected to produce breakthrough innovations that address societal problems such as energy and environmental constraints, the aging and shrinking population, and natural disaster prevention and that contribute to sustainable economic growth and

2. Strengthening the innovation ecosystem through improved bridging

● Promoting focused development that leads to stronger industrial competitiveness

To further enhance the bridging function that was improved during the Fourth Plan, AIST will conduct research that is likely to form more connections with business in cooperative research and that accurately meets industrial needs at advanced levels.

● Stronger functioning as a platform for collaboration and synergies

Using the Cooperative Research Laboratories and OILs as enhanced hubs for the bridging function linking AIST's technological seeds to commercialization, we will strengthen and expand our function as a platform between organizations to encourage collaborations and synergies between many organizations, including collaborations with ministries and government agencies.

● Promoting innovation in the regions

AIST will work to understand the needs of major local businesses and small and medium enterprises, and to promote innovation that invigorates regional economic activity by closely collaborating with local bureaus of economy, trade and industry, public testing and research institutions, and universities.

stronger industrial competitiveness. In response to these expectations, AIST will aim to build a sustainable society—featuring zero emissions, a resource circulation economy, and health and longevity—and to meet the sustainable development goals (SDGs) through our R&D initiatives and activities.

3. Developing infrastructure to support the innovation ecosystem

● Creating even more technology seeds with a view to the long term

To create more key technology seeds and breakthrough technology seeds, AIST will strive to focus even more on long-term, challenging research that is unlikely to produce results in the short term.

● Further improvement of standardization activities

Through the Standardization Promotion Center, AIST will actively work on cross-disciplinary standardization activities that go beyond the conventional scopes of industrial fields, and will improve standardization activities as a whole across AIST.

● Nurturing personnel who can contribute to improved technology management

To create innovation in private companies, it is important to nurture innovation personnel—staff who will contribute to improved technology management in those companies—and to enhance their talents and encourage their activities. Therefore, AIST intends to continuously improve and expand personnel development projects, such as the AIST Innovation School and AIST Design School, and deliver their graduates to society.

[Directions of R&D in the seven research departments]

1 Energy and Environment

With the aim of achieving a zero emission society, we will play a central role in open innovation and promote R&D of energy creation technologies (solar power, wind power, etc.); energy storage technologies (hydrogen, batteries, etc.); energy conservation technologies (power electronics, thermal energy applications, etc.); system technologies for combining these technologies; and resource circulation, life cycle assessment, and risk evaluation so industry can coexist with the environment.

2 Life Science and Biotechnology

Working toward an affluent, energetic, sustainable society, we aim to promote a bioeconomic society that considers health, longevity, and the environment. We will build a platform, based on advanced analysis technologies, of fundamental medical technologies and bioproduction technologies. We will conduct R&D incorporating understanding of life mechanisms that will contribute to medical devices and healthcare, reproduction and “omics” medicine, medical substances manufacture, and advanced bioproduction.

3 Information Technology and Human Factors

To contribute to building an affluent and healthy human-centered society, we will continue from the Fourth Plan in working on the development of AI technologies and cyber-physical system technologies, and we will work on the development of mobility technologies that will expand people's ranges in daily life. Through collaborations with the other research departments, we will develop technologies that contribute to addressing societal problems, particularly the aging and shrinking population. We will further strengthen our collaborations with business and promote goal-focused basic research centered on standardization for digital services and the provision of data coordination infrastructure.

4 Materials and Chemistry

We aim to address societal problems by realizing a circular economy, and to develop advanced resource use technologies and system evaluation technologies. To improve industrial competitiveness, we will work on the development of nanomaterial technologies, smart chemical production technologies, and innovative material technologies. We will promote biodegrading materials for marine plastics and the like, and the standardization of evaluation technologies for functional materials.

5 Electronics and Manufacturing

We aim to create electronic and manufacturing technologies that will upgrade cyber-physical systems. We will conduct R&D of high performance, ultra-low power consumption information processing technologies; high data capacity, low latency, high energy efficiency information communication technologies; and sensing technology infrastructure to enable the collection of many different kinds of data. We will conduct R&D of design and manufacturing technologies to meet the diverse needs of society and industry. We aim to construct technological infrastructure that will transform society and industry; we will work on goal-oriented basic technologies such as next-generation computing technologies, including quantum computing, and the development of new functional materials.

6 Geological Survey of Japan

As the only national center for the Geological Survey of Japan, we will take a medium- to long-term perspective on the preparation of geological information in accordance with the Intellectual Infrastructure Development Plan, the management of geological information, encouraging its use in society and in international collaborations and cooperation. To address societal problems, we will work to develop technologies for environmental evaluation to enable harmony between environmental conservation and cultivation and exploitation of resources. We will work to develop geological information and geological evaluations that contribute to building a resilient country and society, and to provide evaluations of the geosphere that assist industrial uses in order to improve industrial competitiveness.

7 National Metrology Institute of Japan

While developing and providing measurement standards in accordance with the government's Intellectual Infrastructure Development Plan and performing our duties under the Measurement Act, we will promote effective use of measurement standards, upgrade measurement standard traceability systems, and build conformance evaluation infrastructure, including the establishment of industrial standards. We will also work to create next-generation measurement standards and fundamental and innovative measurement technology seeds that will lead to future technology transfers, and to develop a range of measurement technologies that can contribute to solving societal problems.

Introducing the Integrated Fields Project

AIST has declared world-beating solutions to societal problems to be one of the missions of the Fifth Plan. Particularly to achieve the SDGs, breakthrough innovations are needed to address societal problems, such as energy and environmental constraints and the aging and shrinking population, and to contribute to Japan's sustainable economic growth and improving industrial competitiveness. We have specified three societal problems that should be addressed: handling energy and environmental constraints; dealing with the aging and shrinking population; and contributing to a resilient country and disaster prevention.

The whole Institute will work on strategic research projects to contribute to solutions to these societal problems. Synergistic initiatives beyond the scope of existing research departments will be needed for these solutions. As a system for all parts of the Institute to work on research, we are setting up an Integrated Research Center and Integrated Research Laboratories.

Specific initiatives relating to these societal problems are described below.

● Handling energy and environmental constraints

1 Developing fundamental technology for significant greenhouse gas reduction

Setting the Global Zero Emission Research Center as a hub, we promote fundamental research on innovative environmental technologies to achieve

greenhouse gas reduction targets. By implementing demonstration research such as the massive introduction of renewable energy, we are working to achieve a zero-emission society.

2 Developing advanced resource utilization technologies and system evaluation technologies for resource circulation economy

With Resource Circulation Technology Research Laboratory as a core laboratory, we aim to move beyond a resource consumption society and build a resource circulation society. We develop recycling technology of functional materials, resource recovery technology of carbon dioxide and nitrogen oxides originating from functional materials production, and their evaluation technology.

3 Developing the technologies to evaluate, restore and manage the environment to balance utilization of natural resources and environmental conservation

With the Research Laboratory on Environmentally-conscious Developments and Technologies (E-code) as a core hub, we develop and combine relevant technologies to evaluate and monitor environmental impacts as well as to repair and manage the environment. We aim to improve the quality of human life bringing human activities such as development and utilization of natural resources that support society and industry into harmony with environmental conservation.



● **Dealing with the aging and shrinking population**

1 Developing technologies to contribute to next-generation healthcare that blends cutting-edge technologies into daily life

With the Advanced Healthcare Service Research Laboratory as a hub, we will develop technologies that contribute to the creation of innovative and new healthcare services. These technologies will enable early detection of diseases by utilizing data on monitoring the physical and mental state of individuals and big data on health care. The technologies will also promote behavioral changes that lead to good health, thereby extending healthy life expectancy.

2 Developing technologies for improving labor productivity and facilitating skill development and transfer in all industrial fields

A decrease in labor population due to decreasing birthrate and aging population is one of the key challenges in Japan. Industrial Cyber-Physical Systems Research Center and collaborating research units in AIST aim to provide solutions to this issue by integrating AI, robot, and sensor technologies so that machines can coordinate with humans. These technologies will improve quality of work, create new customer values foreseen along with the industrial trend, and facilitate skill development and transfer.

3 Medical treatment and diagnosis technology with high quality, high performance and high precision to improve QoL.

New-generation Medical Treatment and Diagnosis Research Laboratory develops a diagnostic technology to realize active-aging society, medical-device treatment technology with biomedical materials, and a new technology to enhance and maintain the active mental/physical condition from medical intervention to convalescent rehabilitation.

● **Contributing to national resilience and disaster prevention**

1 Developing novel infrastructure integrity diagnostics technologies and operating life-extending technologies for a sustainable, secure, and safe society

With the Sustainable Infrastructure Research Laboratory as a hub, we will develop innovative technologies for infrastructure integrity diagnostics and technologies for extending infrastructure operating lifespans. Through demonstration testing in collaboration with industry, academia, and government, we will quickly bring the developed technologies to practical applications.

Appropriate and trustworthy organizational governance

AIST ensures appropriate management of all operations to make full use of AIST's capabilities and achieve AIST's missions.

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, a Compliance Promotion Committee meeting is held to gather risk information and determine how to address it. Risk information is also shared at regular in-house meetings to prevent recurrence.
- 2 AIST has set a Compliance Promotion Week from 2018 to further raise awareness of compliance of each executive and staff and reliability of AIST. In particular, we put up posters, provide stratified training, and draw action plans for each research discipline.
- 3 In addition to e-learning courses for all staff, 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 “Compladayori,” 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.

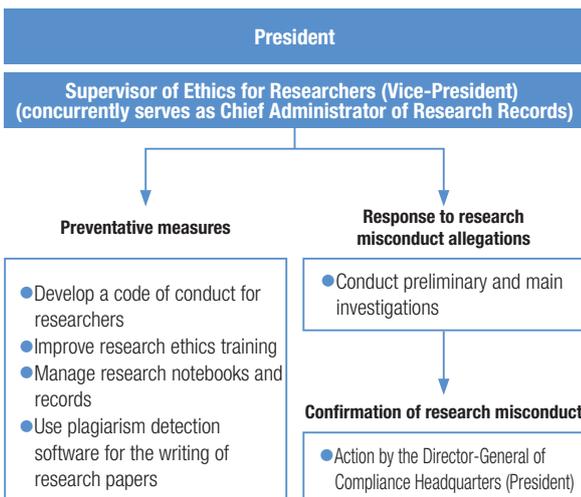
● Addressing research misconduct

- 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 In order to become a research organization trusted by society, a Handbook on the Code of Conduct for Researchers was made and distributed to all the staff that succinctly summarizes into “5 minds” the ethics and points of attention needed in conducting research.
- 3 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, 900 in FY 2017, 1,228 in FY 2018, 1,257 in FY 2019.

● Compliance partnerships with other entities

- 1 In December 2017, the Association for National Research and Development Agencies created an Expert Committee on Compliance with the primary aim of enhancing the risk management of the 27 member agencies. AIST plays a central role as its chair and secretariat.
- 2 In FY 2019, AIST, as the secretariat, held Expert Committee on Compliance meetings in July and February, where the member agencies shared compliance information and discussed challenges and other matters. Furthermore, a Compliance Promotion Week was set by all member agencies, a slogan was decided, identical posters were posted, and executive and official training was conducted.

● Response to research misconduct at AIST



● 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 2019, for the thorough execution of appropriate maintenance and management of research information, we revised, in part, rules concerning research record management and guidelines for application to take out research notebooks, and reexamined the research recording practices. Furthermore, we realized a way for outside agencies to request for disclosure of research notebooks, so that researchers are able to undertake research in a secure environment.

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 by e-learning 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.

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 2019, audits were performed concerning the following topics:

- As cross-sectional themes, information security and personal information management themes 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.
- For research units, a comprehensive audit of research 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 make improvements suggested.

● Collaboration in audits

	Internal audit	Auditor audit	Accounting auditor audit
	← Collaboration →		← Collaboration →
Scope of audit	<ul style="list-style-type: none"> ● Operational audit ● Accounting audit ● Compliance audit 	<ul style="list-style-type: none"> ● Operational audit ● Accounting audit 	<ul style="list-style-type: none"> ● Accounting audit
Points of audit	<ul style="list-style-type: none"> ● Activities as a whole ● Appropriateness of risk management and development and operation of internal control systems ● Improvement of work process efficiency 	<ul style="list-style-type: none"> ● Activities as a whole ● Decision-making by the President ● Creation and operation of internal control systems ● Appropriateness of financial statements 	<ul style="list-style-type: none"> ● Appropriateness of financial statements (effectiveness of internal control systems)

Fair Operating Practices

We conduct appropriate work management based on the law.

Item	Purpose	Action in FY2019
Management of Conflict-of-Interest	Management of conflict-of-interest is conducted based on the rules for conflict-of-interest management.	<ul style="list-style-type: none"> • 3,403 executives and employees who needed to declare their own status of conflict-of-interest all submitted their self-assessments. • 7 employees who had particular concern for conflict-of-interest were interviewed by outside counselors to look into their activities. Additionally, after the Advisory Board consisting of outside experts and the Committee of AIST deliberated, they were notified of points of attention regarding promotion of industry-academia-government collaborations. • Regarding collaborative activities with companies, in order not to give the impression that we are putting profits before public responsibility, we have set and experimentally operated a management system for conflict-of-interest. From FY 2020, it is operated on a full scale.
	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.	Concerning 5 cases in which executives and employees who intended to conduct medical research declared having conflict-of-interest, examination was conducted by the Conflict-of-Interest Management Committee for Clinical Research, whose members include outside experts. Based on this, the leaders of experiments were notified of how to correspond to persons to be studied, and precautions to be taken in presenting results.
Information Security	In order to obtain high-level information security, AIST is strengthening the information network and the management system of information security.	<ul style="list-style-type: none"> ● Information security measures <ul style="list-style-type: none"> • Constant monitoring of external communication and the internal network • Response to information security incidents by the Computer Security Incident Response Team (CSIRT) ● Information security training <ul style="list-style-type: none"> • Maintaining and improving information security awareness by continued information security training ● Information security audit <ul style="list-style-type: none"> • Information security audits conducted of all units and departments
Implementation of Security Export Control	To maintain peace and security within the international community, AIST has tight security export controls in place in accordance with AIST's Rules on Security Export Control (internal rules and regulations), formulated based on the Foreign Exchange and Foreign Trade Act, thereby preventing AIST's technology from being used for the development of weapons of mass destruction.	Through (1) dissemination of the latest information on legislative amendments within AIST; (2) export control training for AIST staff; (3) export control instruction to individual staff members; (4) classification and transaction screening; and (5) internal audits, efforts are being made to raise awareness of security export control at staff level, and as an institution, we are implementing strict export controls.
Promoting Rational Procurement	Under the AIST Rational Procurement Policy (in compliance with the May 25, 2015 decision of the Minister for Internal Affairs and Communications), we 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.	Each year, we formulate an AIST Rational Procurement Policy, and conduct ex-post facto inspections of individual contracts by a Contract Oversight Committee, whose members include outside experts. 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, and the results are publicized. As part of the CSR procurement and 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. 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.
Implementing Market Testing	In accordance with the Basic Policies on Public Service Reform, AIST Tsukuba conducts facility management under procurement contracts.	Continued from FY 2018, the following 7 services are conducted ((1) to (6) up to FY 2020, (7) planned up to FY 2022): (1) maintenance and management of AIST Tsukuba facilities, (2) management of trees and vegetation on AIST Tsukuba premises, (3) safeguarding of AIST Tsukuba, (4) cleaning of AIST Tsukuba buildings, (5) operation and management of the Research Collaboration Center, the Science Square Tsukuba, and the Geological Museum, (6) driving, maintenance, and management of AIST Tsukuba vehicles, and (7) operation and management and user assistance of the information network system. According to questionnaires on facility management of AIST Tsukuba, the satisfaction level of users was over 95 %.



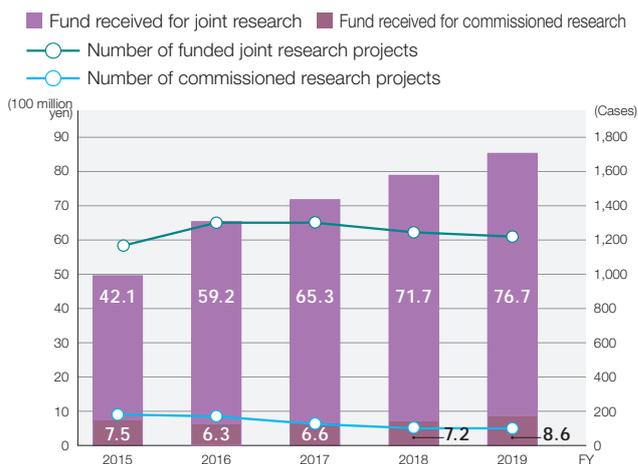
Reference data

Data about promotion of research and development

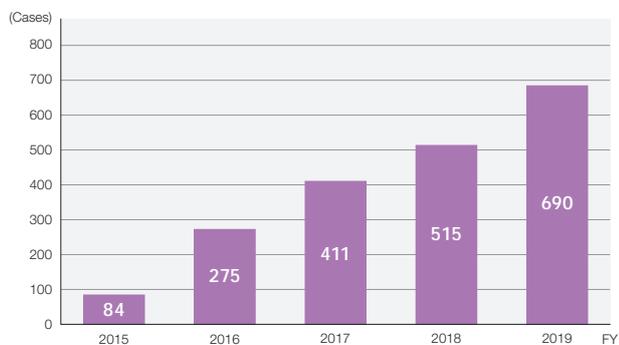
Acceptance of external researchers for joint research



Joint and commissioned research with companies



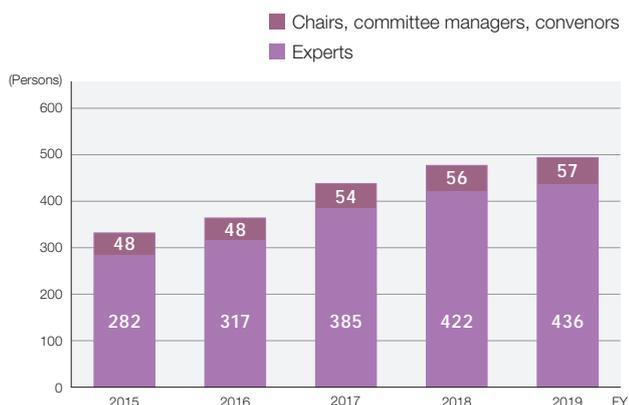
Number of technical consulting



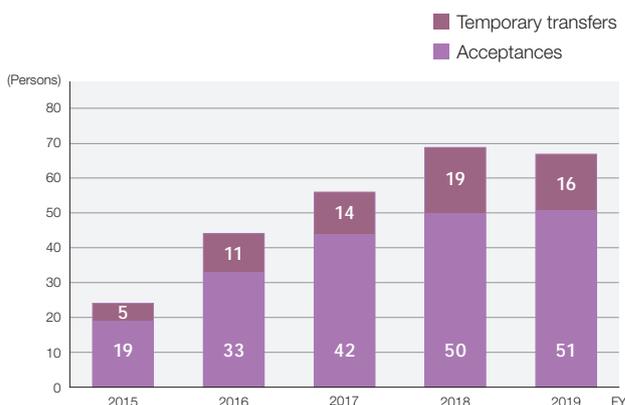
Number of proposed standards



Contribution of AIST staff to international standardization activities

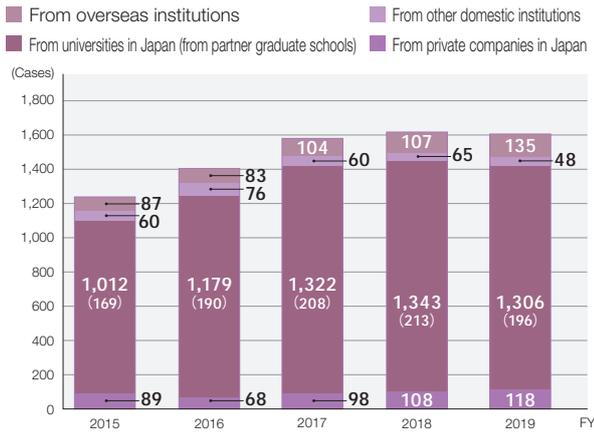


Number of cross-appointment program users

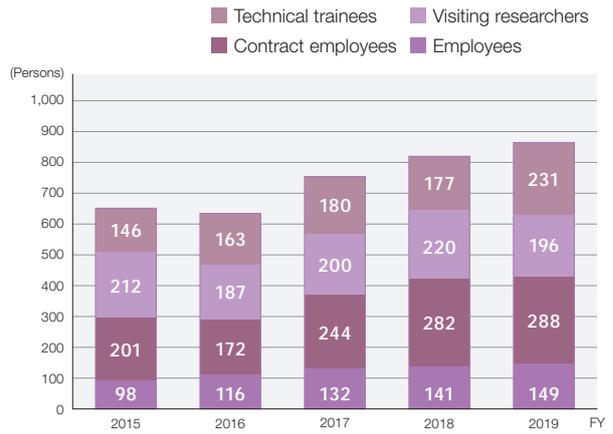


*Includes those who finished the program in the middle of the fiscal year

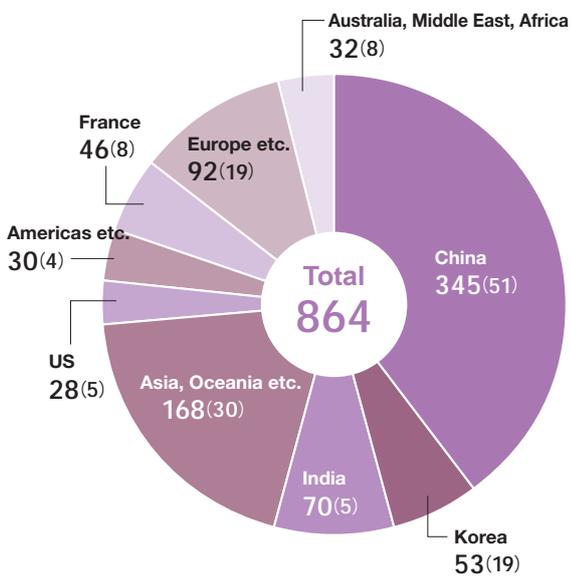
Number of trainees on technical training



Number of foreign researchers



Number of foreign researchers by country and region in FY 2019



*Numbers in parentheses are those with employee status.

Data relating to human resources

Number of people who used the various leave programs

(Persons)

	FY2015		FY2016		FY2017		FY2018		FY2019	
	Male	Female								
Leave to care for sick children	116	185	110	192	124	224	139	217	122	219
Special childcare leave	43	11	32	11	27	14	42	22	39	21
Extended childcare leave*	3	33	4	27	2	38	9	48	17	67
Nursing care leave	47	30	51	37	69	45	72	57	75	59
Extended nursing care leave*	0	2	1	0	2	4	0	8	1	9

*Number of employees starting the leave within the fiscal year

Number of employees who used child daycare services

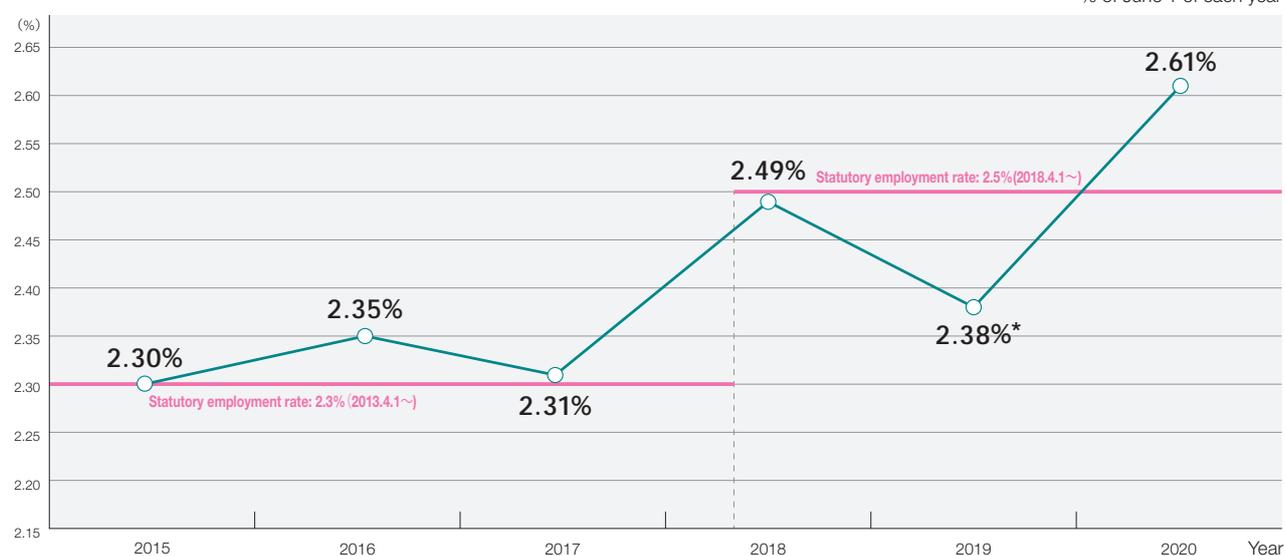
(Persons)

	FY2015		FY2016		FY2017		FY2018		FY2019	
	Permanent employees	Contract employees								
AIST Tsukuba	1,202	864	1,135	1,016	1,872	1,069	1,681	897	834	1,047
AIST Chubu	43	93	7	33	5	112	15	87	93	59
AIST Kansai	228	15	190	10	229	5	136	21	134	45
Private child daycare facilities and babysitters	13	0	7	1	32	26	41	12	43	4

*total number

Change in employment rates for people with disabilities

% of June 1 of each year

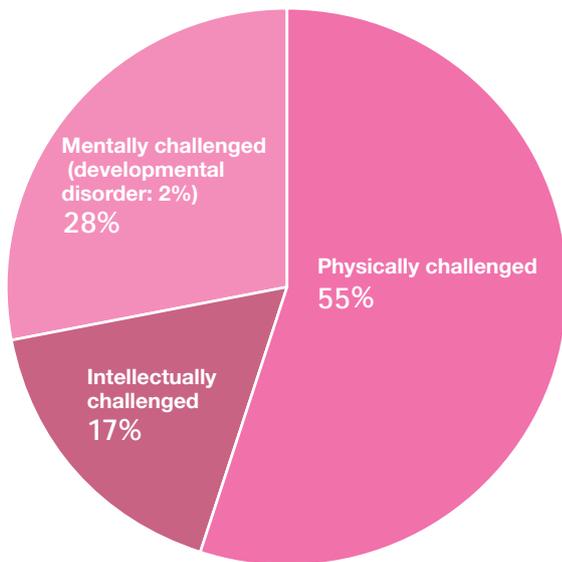


*Correction was made after reinvestigation. As of December 2019, although the actual disability employment rate became 2.49%, the mandatory staffing level (136 employees) calculated from the statutory employment rate of 2.50% was met.

Percentage of people with disabilities remaining at work

	FY2015	FY2016	FY2017	FY2018	FY2019
Number of people at the beginning of the fiscal year	91	87	88	105	111
Number of people who left AIST within the fiscal year	12	10	11	8	9
Employee turnover rate	13.19%	11.49%	12.50%	7.62%	8.11%
Employee retention rate	86.81%	88.51%	87.50%	92.38%	91.89%

Employment rate by disability type

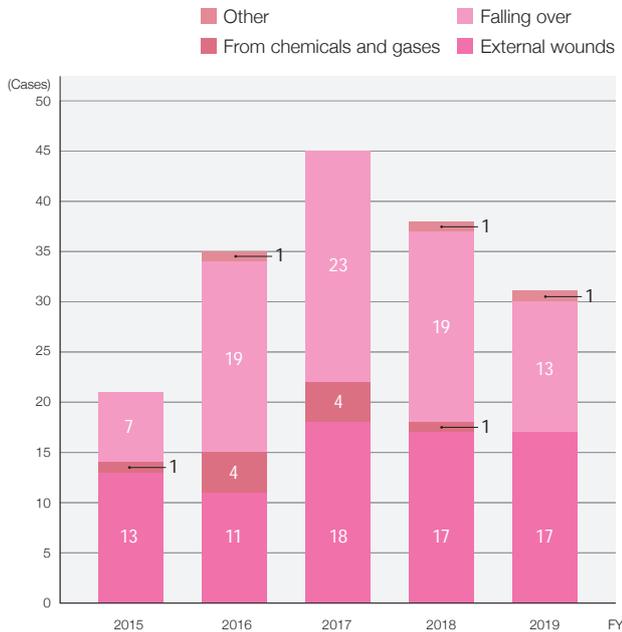


as of June 1, 2020

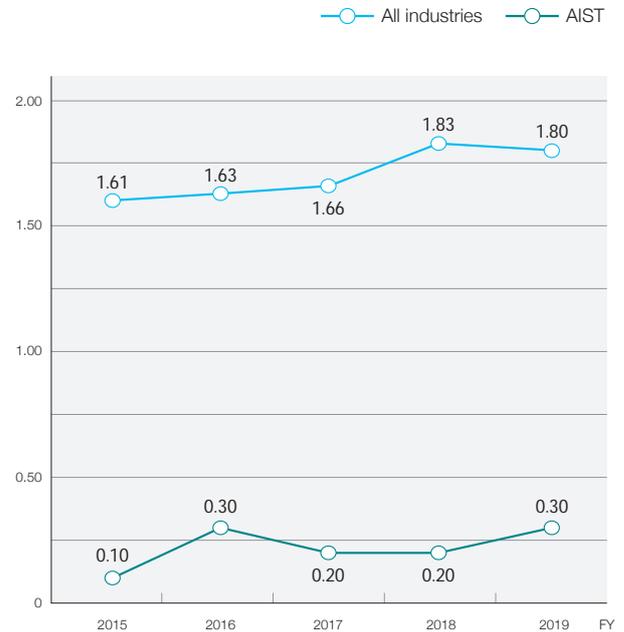


Health and safety data + Health management data

Trends in the number of occupational accidents



Frequency rate of accidents resulting in absences from work



Main education and training programs and workshops held in FY 2019

Program	No. of sessions	No. of participants
Course on skills required for a Health Officer's License	2	65
Course on skills required for a Chief Technician's License for Using Organic Solvents	1	24
Course on skills required for a Chief Technician's License for Using Specified Chemical Substances	1	27
High-pressure gas safety course (for those handling high-pressure gases for the first time)	4	439
High-pressure gas safety course (for those handling high-pressure gases on an ongoing basis)	4	1,231
General safety workshop (for all those responsible for hazardous chemicals, etc.)	4	1,162
Education and training for recombinant DNA experiments (e-learning participants)	1	1,127
Education and training for animal experiments (e-learning participants)	1	289
Education and training on human ethics in life science experiments (e-learning participants) Lecture on Clinical Trials Act	1	239
Education and training for biosafety	1	14
Education and training for those involved in animal experiments	1	107
Joint radiation education and training (for radiation workers)	3	360
X-ray education and training (for new users of X-ray equipment)	87	225
Course on compliance with laws and regulations on radioactive materials (for managers)	1	62

Number and percentage of permanent and contract employees who underwent periodic medical examinations (including health screening), 2015-2019

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

FY	2015	2016	2017	2018	2019
(1) Employees (excluding (2)) *1	99.6% 2,978/2,989	99.7% 3,022/3,031	99.8% 3,061/3,067	99.9% 3,065/3,068	99.8% 2,986/2,992
(2) Contract employees *2	100.0% 2,150/2,150	99.9% 2,319/2,322	99.8% 2,436/2,440	99.9% 2,455/2,456	99.7% 2,569/2,577

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

Number of permanent and contract employees (including temporary employees) who underwent special medical examinations in FY 2019

Special medical examination	Spring			Autumn		
	Permanent employees	Contract employees	Total	Permanent employees	Contract employees	Total
Medical examination for organic solvent poisoning prevention	738/738	758/758	1,495/1,495	740/740	819/819	1,559/1,559
Medical examination for specified-chemical poisoning	445/445	391/391	836/836	440/440	423/423	863/863
Medical examination for ionizing radiation exposure	327/327	129/129	456/456	333/333	139/139	472/472
Medical examination for lead poisoning	10/10	10/10	20/20	10/10	12/12	22/22
Medical examination for laser injury	309/309	151/151	460/460	31/31	35/35	66/66
Medical examination for pneumoconiosis	10/10	24/24	34/34	0/0	7/7	7/7
Medical examination for asbestos exposure	4/4	3/3	7/7	4/4	3/3	7/7

*no. of examinees/ total no. of applicable employees

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

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

FY	2015	2016	2017	2018	2019
With significant findings (D-diagnosis)	103	117	134	152	140
	2.8%	2.5%	2.2%	3.5%	3.1%
With significant findings (E-diagnosis)	818	970	907	822	817
	21.0%	20.5%	14.6%	19.1%	18.3%

(2) Number of employees who received counseling, and their percentages to employees with significant findings

FY	2015	2016	2017	2018	2019
With significant findings (D-diagnosis)	71	98	110	123	121
	68.9%	83.8%	82.0%	80.9%	86.4%
With significant findings (E-diagnosis)	801	862	791	718	726
	97.9%	88.9%	87.2%	87.3%	88.9%

Definition of criteria: 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 in FY 2015-2019

(Cases)

		2015	2016	2017	2018	2019
Industrial physician	Physical	2,020	1,651	1,451	1,573	1,439
	Mental	587	594	540	551	573
Industrial health staff		3,655	3,345	3,356	3,850	5,496*
Total		6,262	5,590	5,347	5,974	7,508

*From FY 2019, the number includes consultations for employees who received health screening at outside medical facilities and overworked employees (based on reform of working practices).

Flu shots (at AIST)

(Persons)

FY	2015	2016	2017	2018	2019
AIST Tsukuba/Tokyo	1,912	1,927	1,876	1,201	2,000
Regional research bases	543	538	664	566	578
Grand total	2,455	2,465	2,540	1,767	2,578

Other activities of health management

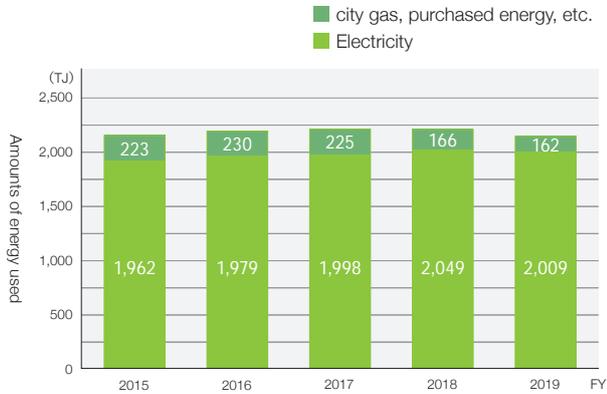
(Persons)

FY	2015	2016	2017	2018	2019	FY	2015	2016	2017	2018	2019
Exercises to refresh	243	219	246	192	198	Mental health seminars	73	133	79	115	55
Walking lessons	-	-	377	175	82	Workshops (training)	180	407	187	227	183
Emergency first-aid workshops	188	154	80	138	145	Anger management workshops	-	-	-	-	119

Environmental Reporting Data

Energy

Changes in amounts of energy used



Progress in renewable energy generation and CO₂ emissions reduction



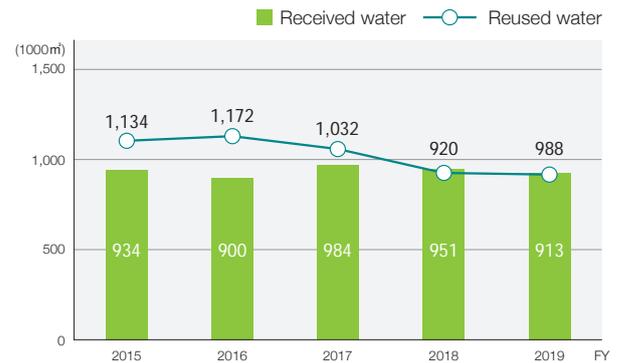
Water resources

Breakdown of water received

Unit: 1000m³

FY	2015	2016	2017	2018	2019
Potable water	914	881	968	937	974
Groundwater	20	19	16	14	14
Industrial water	0	0	0	0	0
Total	934	900	984	951	988

Changes in amounts of water received and reused



Atmospheric emissions

Changes in CO₂ emissions by year



Estimated leakage of CFCs (FY 2019)

Type	R-number	Estimated t-CO ₂ e released by R-number	Estimated t -CO ₂ released by type
HCFC	R22	223.9	223.9
	R32	2.0	
HFC	R134a	123.6	498.9
	R407C	188.9	
	R410A	184.4	
Mixed	Mixed refrigerant	68.8	68.8
Total			791.6

● Changes in atmospheric environmental loads

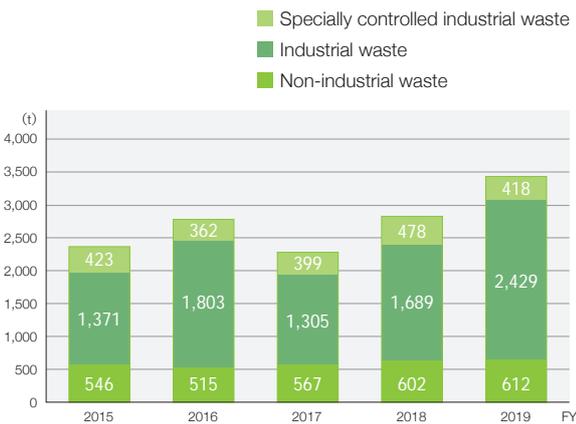


Waste

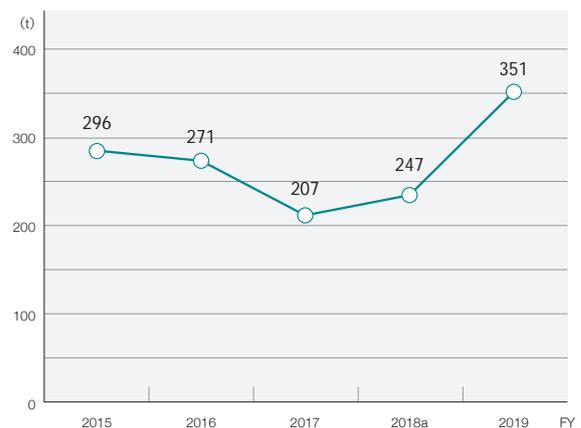
● Breakdown of generated waste (FY 2019)

Waste type	Amount disposed of (t)	Amount landfilled (t)	Percentage of waste landfilled (%)
Non-industrial waste	612	53	8.7
Industrial waste	2,429	277	11.4
Plastic waste	637	93	14.6
Metal scrap	623	35	5.6
Sludge	335	104	31.0
Glass/concrete/ceramic waste	68	17	25.0
Slag	27	0	0.0
Other	739	28	3.8
Specially controlled industrial waste	418	21	5.0
Flammable waste oil	20	2	10.0
Strong acids	324	10	3.1
Infectious waste	17	8	47.1
Waste oil (hazardous)	3	0	0.0
Sludge (hazardous)	12	0	0.0
Acid waste (hazardous)	5	0	0.0
Other	37	1	2.7
Total	3,459	351	10.1

● Changes in amounts of disposed waste



● Changes in amounts of landfill waste



● Storage and disposal of PCB-containing items and PCB waste

Waste type	Quantity stored at the end of FY 2018	Quantity added in FY 2019	Quantity disposed of in FY 2019	Quantity stored at the end of FY 2019	Waste type	Quantity stored at the end of FY 2018	Quantity added in FY 2019	Quantity disposed of in FY 2019	Quantity stored at the end of FY 2019
Capacitors	426	1,359	70	1,715	Oils/paints (L)	106	0	0	106
Electrical ballasts	1,749	1	525	1,225	Other contaminated materials	Stored as research chemicals, etc.	Use of waste cloth used for analysis	—	Stored as research chemicals, etc.
Transformers	2	0	0	2					

Water quality

Monitoring of groundwater at AIST Kansai

Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)
April 2019	0.011
May 2019	0.021
June 2019	0.010
July 2019	0.010
August 2019	0.009
September 2019	0.009
October 2019	0.007
November 2019	0.028
December 2019	0.017
January 2020	0.009
February 2020	0.004
March 2020	0.014

Appropriate Management of Chemical Substances (FY 2019)

Amount of chemicals reported under the Chemical Control Program

Research site	Substance	Amount used	Amount released		Amount transferred
			Air	Sewer	
AIST Tsukuba Central 5	Chloroform(kg)	1,200	300	0	860
	n-hexane(kg)	1,600	370	0	1,200
AIST Tsukuba West	Ferric chloride (kg)	8,400	0	0	0
	N,N-dimethyl acetamide (kg)	1,300	0	0	3,900
	Hydrogen fluoride and aqueous salts thereof (kg)	3,000	0	340	470
AIST Tokyo Waterfront (Bio-IT integrated technology facility)	Acetone(kg)	181	17	0	164
	Chloroform(kg)	151	12	0	139
	Ethyl acetate (kg)	177	5	0	172
	Methanol (kg)	454	39	0	415
AIST Kansai	VOC(kg)	1,800	130	0	1,600

AIST Tsukuba Central 5, AIST Tsukuba West:PRTR Act
AIST Tokyo Waterfront (Bio-IT integrated technology facility): Ordinances relating to the health and safety of citizens and the environment
AIST Kansai: Ordinances relating to preserving the living environment of Osaka Prefecture

Green Procurement, Etc.

Purchase Results of Eco-friendly Goods and Services

Area	Item	Target	Total quantity purchased	Purchase of specified purchase items	Target attainment	
Paper	Photocopier paper	100%	95,607.6kg	95,607.6kg	100%	
	Forms	100%	201kg	201kg	100%	
	Coated paper for inkjet color printers	100%	621.35kg	621.35kg	100%	
	Toilet rolls	100%	5,734kg	5,734kg	100%	
	Tissue paper	100%	11,393.5kg	11,393.5kg	100%	
Stationery	Mechanical pencils	100%	600	600	100%	
	Mechanical pencil leads	100%	444	444	100%	
	Ballpoint pens	100%	12,471	12,471	100%	
	Marker pens	100%	17,369	17,369	100%	
	Media cases	100%	1,007	725	72%	
	Glue (including glue sticks and glue pouches)	100%	2,365	2,365	100%	
	Adhesive tape	100%	692	692	100%	
	Files	100%	139,065	139,065	100%	
Office furniture, etc.	Chairs	100%	1,585	1,585	100%	
	Desks	100%	594	594	100%	
Copying devices	Photocopiers, etc. *	Purchased	100%	0	0	100%
		Leased/rented (new)	100%	11	11	100%
		Leased/rented (extension)	-	223	223	-
	Scanners	Purchased	100%	133	133	100%
		Leased/rented (new)	100%	0	0	100%
		Leased/rented (extension)	-	0	0	-
	Toner cartridges	100%	6,429	6,429	100%	
Ink cartridges	100%	4,063	4,063	100%		
Office equipment	Paper shredders	Purchased	100%	46	46	100%
		Leased/rented (new)	100%	0	0	100%
		Leased/rented (extension)	-	0	0	-
Vehicles, etc.	Non-general official vehicles	Purchased	100%	1	1	100%
		Leased/rented (new)	100%	1	1	100%
		Leased/rented (extension)	-	0	0	-
Fire extinguishers	Fire extinguishers	100%	3,316	3,316	100%	
Services	Passenger transportation	100%	1,459	1,459	100%	

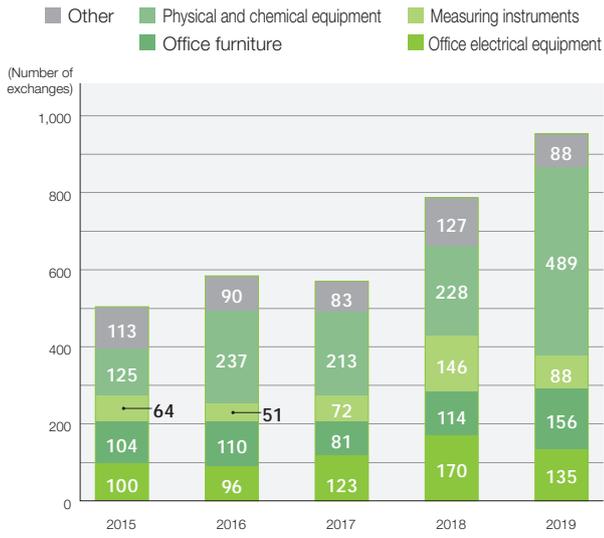
*: Photocopiers, combination units, digital photocopiers with expandable functions

● Number of green contracts (FY 2019)

Type of green contract	Number of cases
Automobile purchase	5
Contract for power supply	5
Industrial waste	21

Reuse of equipment etc.

● Reuse within AIST



Environmental accident drills

● Environmental accident drills in FY 2015–2019

FY	2015	2016	2017	2018	2019
Number of drills	20	18	17	18	19

Third Party Opinion

Since my first draft of Third Party Opinion, it has gone through two rounds of discussions and rewriting. Through these discussions, I have gained a more detailed awareness of the challenges and the state of the Institute. I have been able to verify the transparency, validity and limitations of this AIST Report and to think about what form AIST Report should take in the future, which is very valuable.

The AIST Report has continued to improve year by year, and this year has seen great changes in its structure and in the selection and presentation of content. While it is not stated in the editorial policy; the changes have strengthened the basic role of the AIST Report, which is to provide information that is easy to understand to many people. The number of pages has been reduced. The efforts to avoid excessively lengthy writing and to summarize routine information in tables deserve praise. In the future, I hope more attention will be paid to the increasingly wide-ranging and complex demands of society and that the report will be written accordingly. The Research Reports that were previously included have been cut. These articles were accessible introductions to research that meets the needs of the times, and I imagine many readers would like to see them. I earnestly hope to see them return in the next AIST Report.

This year's report is organized around major themes such as environmental problems, industry-academia-government collaborations, AIST's staff, regional communities, and proper organizational governance. I have previously called for the report to be characterized by materiality, but these categories seem to actually be categories of materiality for AIST. In future, I think identifying important issues in these categories and also giving more detail under other categories will provide a more accurate understanding of AIST.

This year's report devotes most of its attention to a recap of the Fourth Medium- to Long-term Plan and the policies of the Fifth Medium- to Long-term Plan. The Fourth Plan declared "bridging" between various bodies and staff development as its principal missions. Looking back at the AIST Reports since 2015, I see that virtuous circles have steadily emerged in these missions. This seems to me like shafts of light breaking through the clouds of "the declining influence of Japanese companies," "the limits of

self-sufficiency in research," "inadequate infrastructure for promoting innovation," and "low research productivity." The situation is summarized honestly by "produced circumstances in which it is difficult to properly fulfill the role of ... providing balanced responses to the various requirements." "Various requirements" implies solutions to the societal problems we are facing. Therefore, I can well understand the importance of the mission of the Fifth Plan. The SDGs are presented as challenges that should be overcome to produce a desirable situation in 2030. I understand the mission of the Fifth Plan as responding to expectations of AIST working to achieve the SDGs. I think many citizens' hopes are addressed by the Basic Policy mentioning "to meet the SDGs" and the Top Message saying "We will have to strive with all our strength to achieve this." I wonder how the results will be presented in Research Reports.

I was expecting the effects of and responses to COVID-19 to be described in this year's report. The report meets my expectations to some extent with the column summarizing the work on infection prevention and research activities. However, many people will be concerned that the intellectual networks that support cooperative research activities with foreign researchers may have been damaged. If this worry is needless, people will still wonder if a new style of cooperative research activities is emerging. I would like to see some examination of this in next year's AIST Report.

I really felt from discussions of the lead article that there were many discussions between relevant departments and offices in the process of producing this AIST Report. The conclusions that emerged from this process are clearly valid within AIST. However, these conclusions do not necessarily coincide with the concerns and values of ordinary people and other stakeholders. The way to check this is through stakeholder dialogs. To qualitatively improve the AIST Report, please work on being more open.

Workers Club for Eco-harmonic Renewable Society (NPO)

YAMAGUCHI Tamio, Director

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 leading to a sustainable mode of society for regional citizens, businesses and governments. At CSR workshops within the club, the group studies and proposes appropriate forms of CSR.

On the publication of the AIST Report 2020

AIST has been publishing environmental reports since 2004, as 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 Top Message is delivered by ISHIMURA Kazuhiko, who was appointed as President of AIST in April 2020. The report features the Global Zero Emission Research Center (GZR) that was established in January 2020. The Opening Interview is with YOSHINO Akira, Director of GZR, and the teams and research at GZR are introduced. The reports include a column about protective measures against the COVID-19 disease that

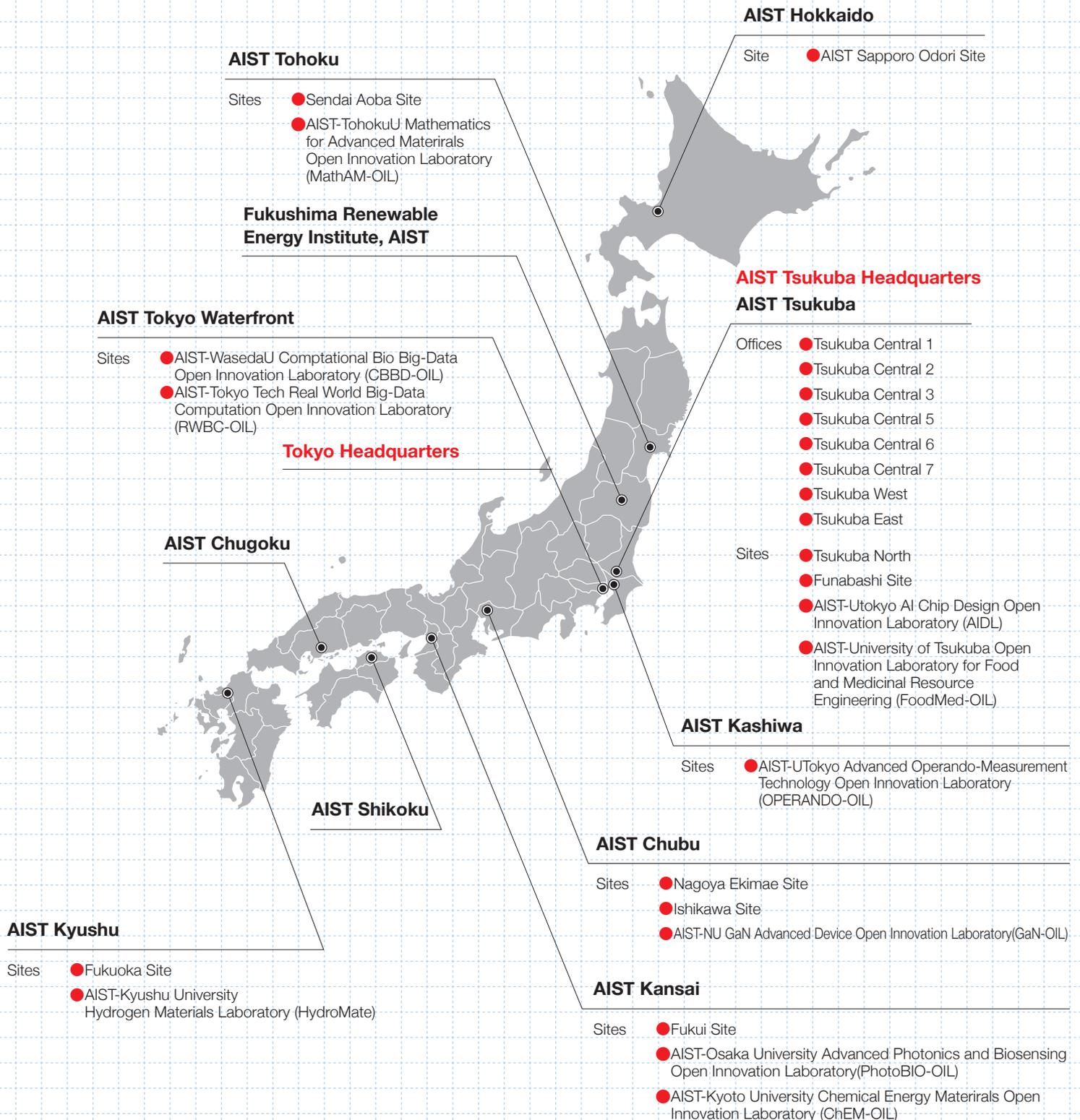
has been a pandemic since Spring 2020. In Third Party Opinion, YAMAGUCHI Tamio of the Junkan Workers Club offers invaluable thoughts and guidance.

FY 2020 is the first year of our Fifth Medium- to Long-term Plan. With the motto "in society, for society," we are taking advantage of AIST's integrated capabilities in projects to solve societal problems. At the same time, we are building on the improvements that we have achieved in our "bridging" function. 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 make connections to build relationships of deeper trust with society.

Vice President and Director, Public Relations Department **KATO Kazumi**

Research Bases

as of Sept.30,2020



Public Relations Department

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