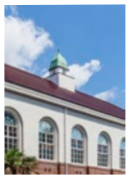
TOHOKU UNIVERSITY

INTEGRATED REPORT 2023



Cover: Tohoku University was founded on the principles of “Open Doors,” “Research First,” and “Practice-oriented Research and Education,” and we have been home to a diverse range of people for more than 100 years. In 1913, Tohoku University became the first university in Japan to admit female students. To mark the publication of the Integrated Report for 2023, the cover features the Tohoku University Archives, which houses numerous historical records on the rich diversity of the people at the university, including documents related to the history behind Japan’s first female students. The cover represents the 110 years since female students were first admitted and symbolizes the University’s history of diversity and equity.

TOHOKU
UNIVERSITY

We are pleased to announce the publication of our third Integrated Report since 2021.In order to communicate our perspective as a comprehensive university, with characteristics distinct from those of a regular, for-profit corporation, we "comprehensively" integrate our financial information (quantitative data) with our non-financial information (qualitative data) on education, research, community co-creation, and management to provide our stakeholders with a clear understanding of the direction that Tohoku University is heading and the value that we are creating for communities.
In line with our origin as a university growing together with society, we hope that this report serves as an opportunity to further enhance these efforts in co-creation through dialog with all of you.

Scope of the Report:
National University Corporation Tohoku University

Period of the Report:
April 1, 2022, to March 31, 2023 *Includes some information from outside of this period.

Guidelines Referenced:
International Integrated Reporting Framework, International Integrated Reporting Council (IIRC)
Recommendations of Task Force on Climate-related Financial Disclosures (TCFD)

Origin of the University Official Symbol and School Colors: The logo was developed in March 2005 based on the key concepts of “Creativity,” “Global,” and “Tradition,” with a motif that incorporates the hagi plant, the native bush clover that has long symbolized Sendai. The logo was adopted as the university’s official symbol in June 2007. The shape of the logo represents the dignified movement of the hagi as it spreads further out into the world. The colors purple and black have also been selected as official colors. Purple symbolizes intelligence and creativity, while black represents diligence and practical skill. With the adoption of the university official symbol, purple has also been adopted as the school color.

A New Vision for the University, Becoming a Value Creation Platform

Hideo OHNO
22nd President of Tohoku University

Introduction

Tohoku University was founded in 1907 and is well known for its guiding principles of putting research first, having an open-door policy and committing to practice-oriented research and education.

Despite being Japan's third national university, Tohoku University has been first in many ways that matter. We were the first university in the country to accept women and one of the first to welcome international students.

These days, Tohoku University is a vibrant academic community, home to 18,000 students across 10 faculties, 15 graduate schools and six research institutes. About 10 percent of our students come from abroad, contributing to one of the most cosmopolitan academic environments in Japan.

Our diverse student population and research achievements, coupled with our wide network of collaborative partners, have earned us recognition from the Japanese government. In June 2017, we were among the first three institutions to be awarded the status of a Designated National University and we are currently the only remaining candidate for the "University for International Research Excellence" government project, which aims to boost research activities at Japanese universities.

And in March 2023 - for the fourth year in a row - Times Higher Education ranked Tohoku University number one on its annual list of Japanese universities, highlighting our learning environment, international outlook, and research influence.

Open Doors: Diversity, Equity and Inclusion

This year, we celebrate the 110th anniversary of our first female students. On August 21, 1913, the official gazette announced the admission of three female students to Tohoku Imperial University, the precursor to Tohoku University. That moment broke the gender barrier in Japanese higher education, marking the first time in the country's history, that female students were accepted into a national university.

Those three extraordinary women - Chika Kuroda, Ume Tange and Raku Makita - were not only trailblazers as students, but also in their successful post-graduation careers.

Another pioneering alumnus was writer Lu Xun, a leading figure of modern Chinese literature. He was a student at the Sendai Medical College, which later became the School of Medicine. His experiences in Sendai are immortalized in a famous collection of short stories, many of which revolve around his professor Genkuro Fujino, who provided support and care during a time when international students were a rarity in Japan.

For over a century, our unwavering "Open Doors" policy has welcomed talented individuals, irrespective of gender, ethnicity, nationality, or economic background.

In April last year, the university unveiled the "Tohoku University Diversity, Equity and Inclusion (DEI) Promotion Declaration," renewing our commitment to create an environment where all voices are heard and respected.

Practice-oriented Research and Education: Creating New Social Values

Tohoku University has always been committed to fostering a culture of practice-oriented research and education, with the ultimate aim of positively impacting our communities.

To that end, we have used our research success to address a wide range of challenges. These include building resilience in the aftermath of the 2011 Great East Japan Earthquake and Tsunami, and establishing a Green Goals Initiative to promote future sustainability.

For over a decade, Tohoku University has been a global leader

in the development of disaster science and risk mitigation strategies through our International Research Institute of Disaster Science (IRIDeS). For example, we are proud to have developed RTi-cast, a system adopted by the Japanese government that provides real-time data on tsunami inundation and damage estimation using our supercomputer.

At the 3rd World Bosai Forum held in Sendai earlier this year, we submitted recommendations to the United Nations Office for Disaster Risk Reduction (UNDRR) on ways to increase global resilience. These recommendations will contribute to the Midterm Review of the Implementation of the Sendai Framework for Disaster Risk Reduction.

An integral part of building resilience is also improving healthcare. And at the Tohoku Medical Megabank Organization, which houses Japan's largest population biobank, we are working on developing personalized medicine research that will significantly enhance healthcare across the country.

Currently, we are building a 40,000m^2 Science Park on the new extension of Aobayama campus. Upon completion, it will serve as a hub for advanced science and technology research and development, and is expected to draw investments from private companies and industry.

Together with NanoTerasu, the next generation synchrotron radiation facility due to begin operations in 2024, the Science Park is set to become one of Japan's premier research complexes for developments in public-private partnerships.

Research First: Towards a New Model for the University, Becoming a Platform for Value Creation

We envision a future where Tohoku University will pursue excellence in research and education on a scale greater than ever before. Going beyond the framework of conventional institutions of higher education, we hope to evolve into a modern platform that creates value through engagement and co-creation with society.

Tohoku University aims to establish a new research ecosystem that will further provide the means for positive change in the world. We are dedicated to fostering an open environment that welcomes diverse talents, promotes internationalism, and develops a research support system that will enable researchers, especially those in the early stages of their careers, to make rapid progress.

We are strategically working on increasing and enhancing engagement, including the creation of startups, facilitating funding flow, nurturing talented individuals capable of creating social values through research and co-creation, promoting entrepreneurship, and implementing management reforms to support these initiatives.

Excursion during the G7 Science and Technology Ministers' Meeting in Sendai, and Official Side Event High-Level Meeting "Quantum Innovation for a Better Future"

To Our Stakeholders

This integrated report presents our financial information in combination with our non-financial information related to education, research, societal co-creation, and management. It aims to clearly communicate Tohoku University's future roadmap, the direction taken and planned contributions to societal value creation as the community as a whole embarks on the challenge of redefining the role of research universities in Japan. We hope this report will serve as a catalyst to deepen our collaboration through dialogue with all of our stakeholders.

Thank you all very much, and I look forward to your continued support.

Achieving a Virtuous Cycle of Education, Research, and Community Collaboration based on Our Founding Principles of “Research First,” “Open Doors,” and “Practice-oriented Research and Education”

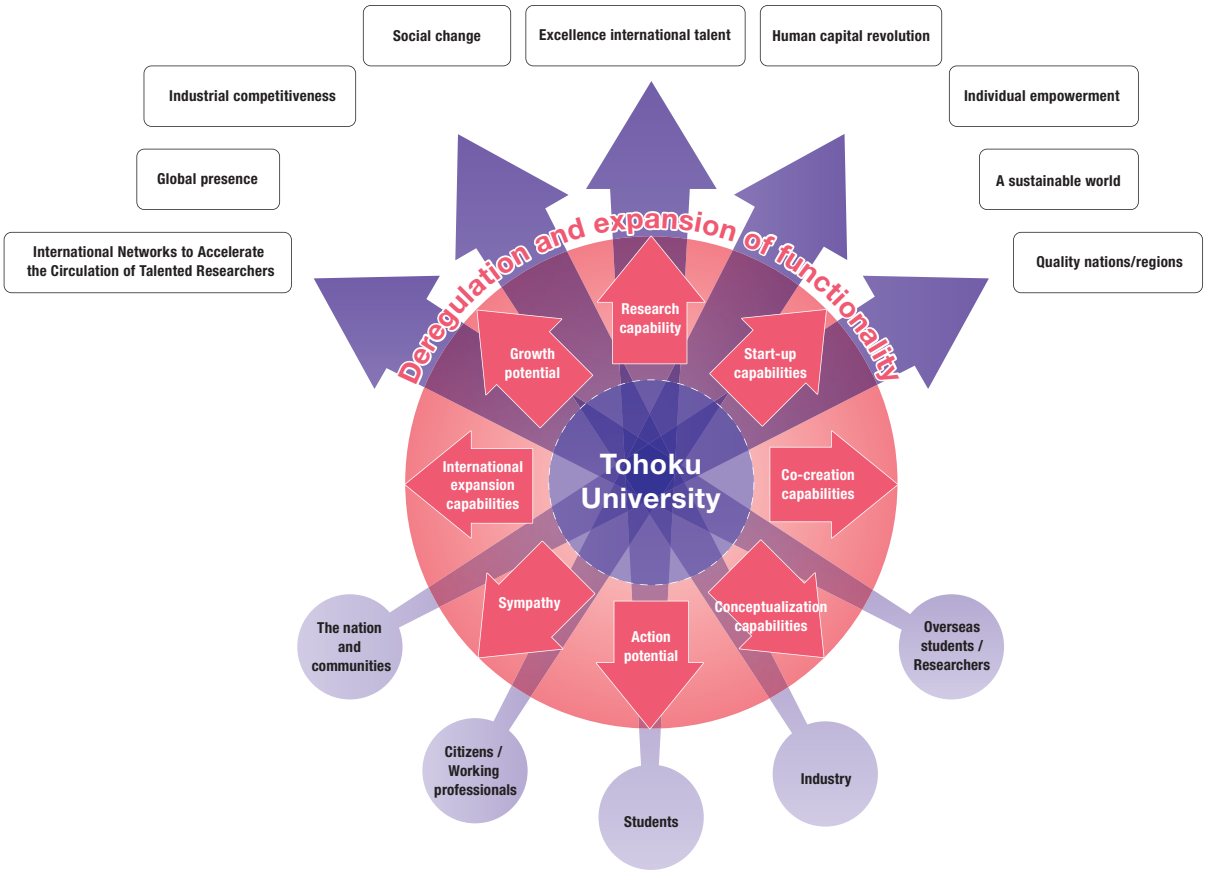
The three principles of Tohoku University are “Research First,” “Open Doors,” and “Practice-oriented Research and Education.” These are also the driving forces that effectively link together the University's various activities in education, research, and community collaboration. First, the tradition of “Research First” refers to fostering outstanding, bright individuals who will pioneer the future through their research while creating internationally distinguished research findings. Second, our “Open Doors” principle refers to accepting talented people regardless of nationality, gender, or other characteristics to demonstrate the power of diversity and provide society with the further enhanced talents of these individuals. Third, “Practice-oriented Research and Education” refers to the creation of new social values based on original research findings. The virtuous cycle of education, research, and community collaboration enabled by these three principles promotes co-creation by transcending boundaries and forms the foundation of Tohoku University’s vision for the future.

Governance as a University Engaged With Society

Engagement-Oriented University Management Based on the Corporate Governance Code

Tohoku University is committed to engagement-oriented university management with an emphasis on relationships with a diverse range of stakeholders, and aims to transform itself toward a value creation platform with the participation of a diverse array of actors. To this end, we need to build a relationship of trust with communities in our ever-developing public role, and as an aspect of this, we inspect and publicize our governance from the perspective of the National University Corporation Governance Code as well as the Corporate Governance Code for companies listed on the Tokyo Stock Exchange, as a unique initiative not seen in other universities.

Toward a Value Creation Platform with the Participation of a Diverse Array of Actors



[Corporate Governance Code]

The Corporate Governance Code is a set of principles outlining basic matters of governance for companies listed on the Tokyo Stock Exchange. It covers the principles of conduct necessary for universities to gain the trust of a wider variety of stakeholders through proactive and active responses to sustainability-related issues, investments in human capital and intellectual properties, and other means.

Ever since its establishment as Japan's third national university, Tohoku University has continued to benefit from the support of the local community and private companies as a university engaged with society. In the University's ever-developing public role demonstrating its true value through collaboration with a variety of stakeholders, Tohoku University will continue to implement engagement-oriented university management with an emphasis on relationships with its stakeholders.

The following are some examples of the University's activities based on the aims set forth in the Corporate Governance Code.

Sustainability

Corporate Governance Code Supplementary Principle 2-3 (1)

Addressing sustainability-related issues

- **Activities to achieve net zero carbon in 2040** Details on p.10-11
- **Issuance of university bonds (Tohoku University Future-Creation Bonds) in the form of sustainability bonds (SDG Bonds)** Details on p.20-23
- **The first university in Japan to participate in the TNFD Forum** Details on p.40-41
- **Hosting of the 3rd International Disaster Risk Reduction Conference** Details on p.48-49

Corporate Governance Code Supplementary Principle 3-1 (3)

Improving information disclosure

(sustainability activities, status of investments in human capital, etc.)

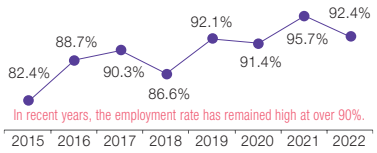
- **Details of disclosure on climate change actions based on the TCFD** Details on p.10-11

- **Career support for doctoral students and post-doctoral fellows**

The PhD Career Development Unit (PhDC) was established to provide doctoral students and post-doctoral fellows with career support. We continue to improve our career support system by aiding in the development of transferable skills applicable to multiple specialized fields in addition to internship training and other job-hunting support.

PhD Career Development Unit ▶ https://pgd.tohoku.ac.jp/phdc/en/

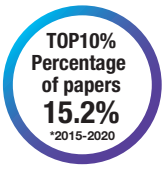
Employment rate for doctoral students (supported students)



- **The Frontier Research Institute of Interdisciplinary Sciences (FRIS), which provides an independent research environment for young faculty members**

FRIS provides an independent research environment, recruits outstanding young researchers through an international public recruitment process, and by enhancing support for research funding, creates an environment in which young researchers can devote themselves to their research as principal investigators (PIs).

Frontier Research Institute for Interdisciplinary Sciences ▶ https://www.fris.tohoku.ac.jp/en/



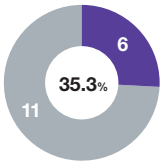
Diversity

Corporate Governance Code Supplementary Principle 2-4

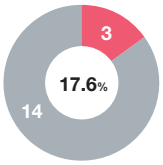
Diversity

- **Diversity-conscious management system**

We are building a management system that emphasizes diversity in terms of gender, background, and other attributes, and 35.3% (6 out of 17) of the members of the executive committee (president, executive vice presidents, and vice presidents) are from outside of the University, and 17.6% (3 out of 17) are women. (As of April 2023)



Percentage from outside of the University



Percentage of women

- **Establishment of a Student Council**

We were the first national university to establish an official system to reflect student opinions in university management through direct dialog. In this way, a diverse range of opinions are able to influence the management of the University.

- **Release of the Tohoku University Declaration of Diversity, Equity, and Inclusion (DEI)**
- **Enactment of Guidelines on Sexual Diversity**
- **Fostering the next generation of female researchers through the Science Ambassador System**

Details on p.12-13

Toward a Sustainable Future

- Resolving Environmental and Social Issues -

Climate Change Actions (Compliance with TCFD)

Tohoku University will analyze and evaluate the impact of climate change, identify climate change risks and opportunities, and proactively disclose information on its activities to address climate change, including the financial impact (provisional calculation) to achieve the goals of Tohoku University Green Goals Declaration.

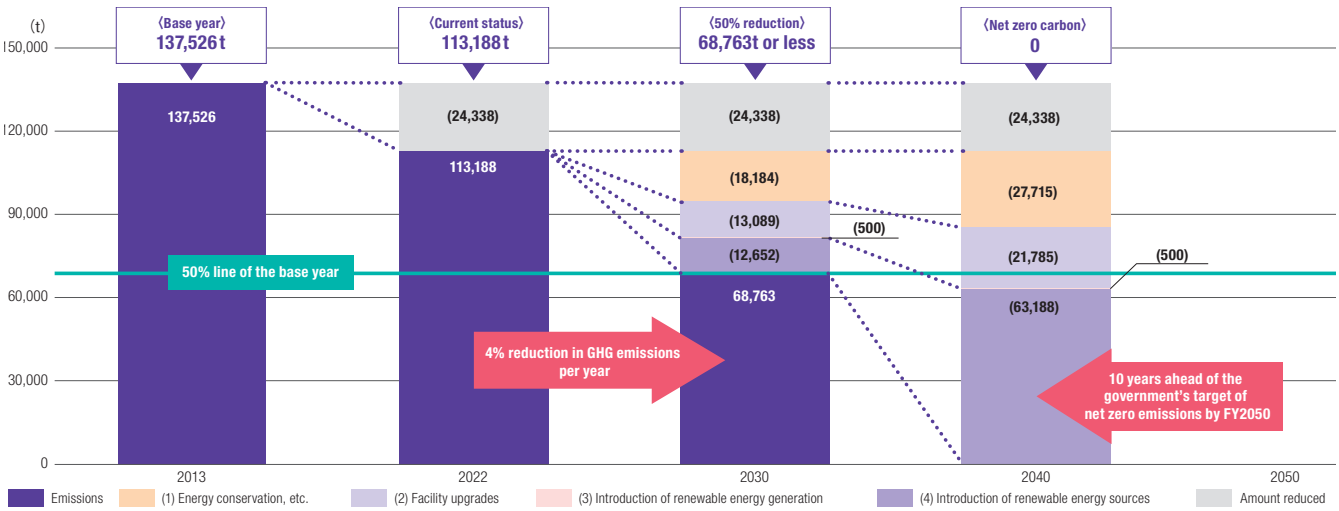
	Impacts of climate change	Examples	Strategy and risk management		Provisional calculations through FY2030: Financial impact/year	Provisional calculations through FY2030: Greenhouse-gas reduction/year
Transition risk	Strengthening of national environmental regulations	•Increased costs due to the introduction of a carbon tax •Increased costs to achieve carbon neutrality	•Reduction of greenhouse-gas emissions •Reduction of energy costs •Upgrading to renewable energy facilities •Transition to electrification and clean electrical power	Carbon tax	Approximately JPY 820 million	-
Transition risk	Transition to renewable energy	•Increased demand for renewable energy, rising prices •Increased costs due to the upgrade of energy-conserving facilities		Renewable energy sources	Approximately JPY 90 million	(4) 1,600t-CO_2
				Facility upgrades	Approximately JPY 900 million	(2) 1,600t-CO_2
Physical risk	Damage caused by typhoons, torrential rains, etc. / Supply-chain disruptions	•Infrastructure and other supply suspensions, flooding of buildings due to flying debris, inundation, etc. •Delay in procurement of materials and equipment for research and experiments, etc. •Suspension of education and research activities, etc.	•Preventive maintenance (strengthening vulnerable areas) •Post-incident maintenance (disaster recovery) •Stockpiling of frequently used materials and equipment for research and experiments, etc.	Damage to facilities and equipment	Approximately JPY 50 million	-
Opportunities	Behavioral changes	•Strengthening activities to reduce one's own greenhouse-gas emissions and energy use Research promotion and technology development	•Strengthening energy conservation activities •Reducing administrative work through digital transformation •Reducing travel between campuses through online conferencing	Energy conservation, etc.	Approximately JPY (490) million	(1) 2,300t-CO_2
				Reduced administrative work	Approximately JPY (170) million	
Opportunities	Research promotion and technology development	•Strengthening activities to promote research, develop technology, etc., that relate to intellectual contributions and mitigation measures related to climate change	•Developing technology and readying society for renewable energy, hydrogen utilization, etc. •Developing high-performance storage batteries, etc.	Research investment / Technology-development revenue	-	Contribution to the reduction of greenhouse-gas emissions in society as a whole
Opportunities	Business Continuity Plan (BCP) (utilizing the experience of the Great East Japan Earthquake)	•Infrastructure-supply suspensions •Suspension of education and research activities, etc. •Intake and support of local residents, etc.	•Renewable energy generation investment and use •Early resumption of education and research activities, etc. •Supplying the city during power outages	Renewable energy generation	Approximately JPY 30 million	(3) 60t-CO_2

*TCFD refers to the Task Force on Climate-related Financial Disclosures, which was established by the Financial Stability Board (FSB) at the request of the G20 and is chaired by Michael R. Bloomberg. It studies climate-related disclosure practices and the way financial institutions respond. The TCFD published its final report in June 2017, recommending that companies and other institutions disclose information related to climate change-related risks and opportunities.

Toward Carbon Neutrality by FY2040

Tohoku University aims to reduce greenhouse-gas emissions on its campuses by 50% by FY2030 (in comparison to FY2013), and to achieve net zero emissions by FY2040.

National Greenhouse Gas Reduction Targets: Reduce greenhouse gas emissions by 46% from the FY2013 level by FY2030, and achieve carbon neutrality by FY2050



Recognizing that global environmental conservation is one of the most important issues common to everybody, and aiming to serve as a model for society in the near future, Tohoku University engages in environmentally-conscious activities in all aspects of its educational and research activities with a view to building a sustainable society. Specifically, in order to embody its role as a university working hand in hand with society, Tohoku University remains sincerely committed to global environmental conservation, the most important issues common to all of humankind, by actively reducing the environmental impact of its operations, fostering environmentally-minded talent, promoting environment-related research, and disclosing environment-related information.

Carbon neutrality on University campuses

In accordance with national strategies such as the Global Warming Countermeasure Plan, Tohoku University aims to achieve “Nearly ZEB” status or higher for new buildings and at least “ZEB Ready” status for existing buildings.

In May 2023, work was completed on Kita-Aobayama Center Square, a renovation of existing buildings.

Kita-Aobayama Center Square loosely connects the dynamic space of the Kita-Aobayama Commons with the static space of the library via the Knowledge Corridor (an enclosed connecting passage), creating a diverse venue enabling a broad range of activities. In addition, in order to create a space to encourage dialog and exchange among students, faculty, staff members, and a variety of other parties, an event space was set up in the library to serve as a venue for educational and research activities open to visitors from outside of the university, transforming the area into an Innovation Commons.

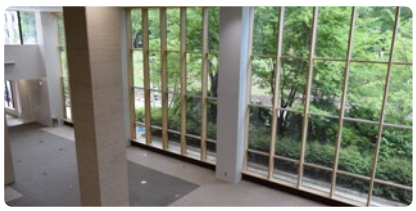
In the process of renovating, the insulation capabilities of the exterior walls and roof were improved by incorporating vacuum double glazing and double-hung sash windows, while high-efficiency air conditioning, LED lighting, and image-recognition-based motion sensors for lighting were installed to ensure energy conservation. In addition, in consideration of the campus landscape and environment, photovoltaic power generation panels (220KW) were installed on the roofs of the buildings. These efforts have resulted in energy conservation of 54% and energy creation of 23%, for a total energy reduction rate of 77%. Thanks to these renovations, the buildings have now acquired “Nearly ZEB” status.

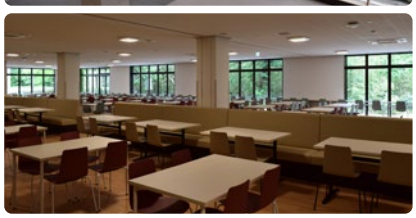
Going forward, we will continue to reduce energy consumption and advance carbon neutrality on the University’s campuses, while also promoting community co-creation, research and development, and the fostering of talent that will contribute to realizing a green society to ensure a sustainable future for the global environment and humankind.

Conventional buildings	ZEB Ready	Nearly ZEB	ZEB
Energy required by conventional buildings 100%	Energy conservation results in a reduction to 50% or lower	Energy conservation + energy creation results in a reduction to 25% or lower	Energy conservation + energy creation results in a reduction to 0%
	Reduce: Energy conservation	Reduce: Energy conservation Create: Energy creation	Reduce: Energy conservation Create: Energy creation

Kita-Aobayama Center Square (completed in May 2023)

(Upper) Library / (Middle) Commons / (Lower) Knowledge Corridor

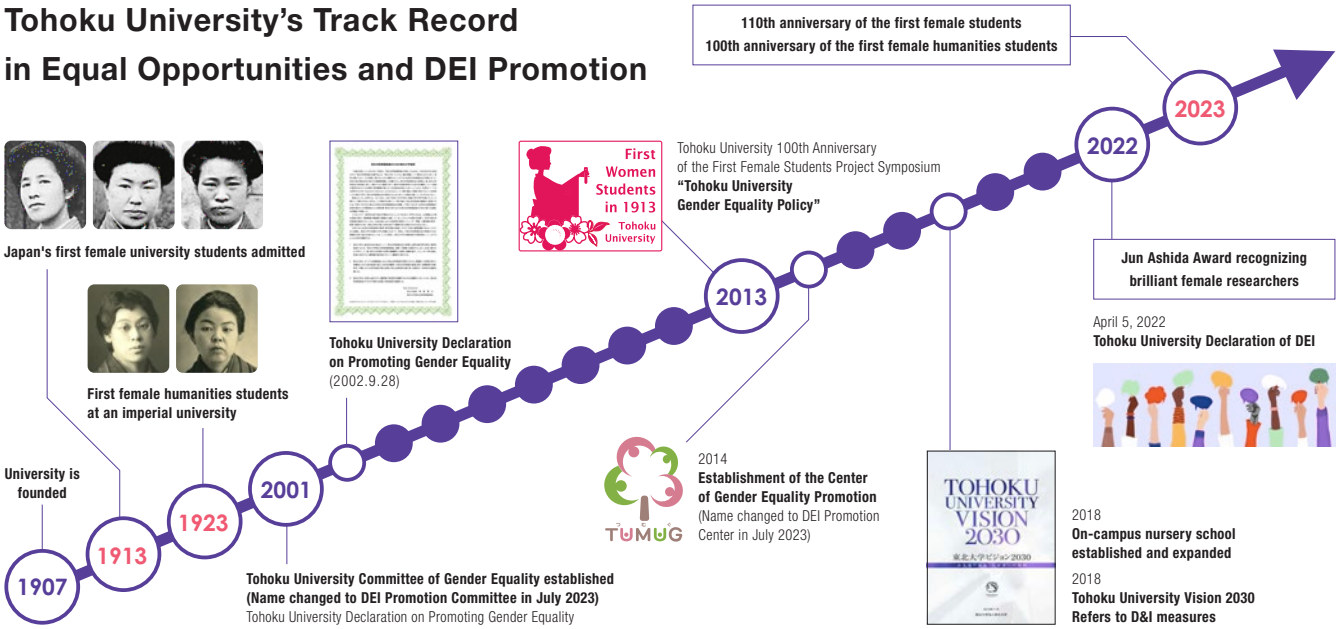




Diversity

- Realization of an Educational, Research, and Work Environment Inclusive of Diversity and Equity -

Tohoku University's Track Record in Equal Opportunities and DEI Promotion



Declaration of DEI & Enactment of Guidelines on Sexual Diversity

Tohoku University released the Tohoku University Declaration of Diversity, Equity, and Inclusion (DEI) on April 5, 2022, to carry on and further develop the Declaration on Promoting Gender Equality, Gender Equality Policy, and other basic policies. The Declaration upholds diversity, equity, and inclusion, and states that the University shall promote awareness-raising and the development of an environment and systems to ensure that all members respect diversity and that the diversity of all members is respected. As the world enters a period of great change, Tohoku University will continue to promote diversity, equity, and inclusion (DEI) as set forth in the Tohoku University Declaration of DEI in order to continue taking on the challenge of creating new value to bring happiness to humanity, both now and in the future, by mobilizing the diverse knowledge of which Tohoku University is proud.

Tohoku University -Live as Who You Are-

Guidelines for Gender and Sexual Diversity

It is necessary to appropriately address the awareness of sexual diversity that has been growing in recent years. With the aim of realizing an environment in which students, faculty, and staff members respect sexual diversity in their studies, research, and duties at the University, these Guidelines set forth the following policies and specific measures. The University will also develop and expand a variety of other systems and facilities, including a one-stop consultation services, to raise awareness among its members.

- We will respect equal human rights of all members and promote DEI.
- We will promote awareness-raising and the development of an environment and systems to ensure that diverse sexualities are respected.
- We will be supportive of diverse sexualities and will not discriminate on the basis of sexuality.
- We will strive to reduce any inconveniences and disadvantages caused by sexuality, and will continue to discuss issues and proceed together in a future-oriented manner, even for issues that are unsolvable at present.

We will pursue gender parity to eliminate the gender gap, and work to reform views through awareness-raising activities to dispel unconscious biases in order to realize diversity. Based on internal surveys and analyses, we will also provide an environment that guarantees equity so that all students, faculty, and staff members are able to maximize their individual abilities, and work to create an organization rich in inclusiveness.

Fostering the Next Generation of Female Researchers through the Science Ambassador System

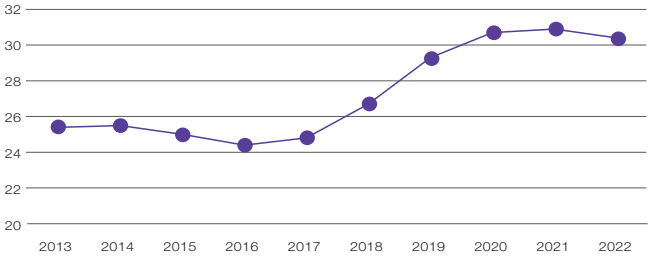
(Winner of the 4th Brilliant Female Researchers Award (Jun Ashida Award))

The Japan Science and Technology Agency (JST) named Tohoku University winner of the 4th Brilliant Female Researchers Award (Jun Ashida Award), and Vice President Noriko Osumi attended the award ceremony held at the National Museum of Emerging Science and Innovation on November 6, 2022.

Vice President Noriko Osumi of our university receiving award from President Kazuhito Hashimoto of the Japan Science and Technology Agency (JST).

The award was given in general recognition of the University's potential to serve as a model for other institutions, such as the University's efforts in encouraging female junior and senior high school students to enter the sciences through the Science Angel System (currently the Science Ambassador System), as well as university-wide efforts to increase the percentages of female faculty members and female doctoral students by actively hiring female faculty members and promoting them to higher positions.

Percentage of Female Ph.D. Students (%)



Ceremony and Lectures Commemorating the 110th Anniversary of the First Female Students

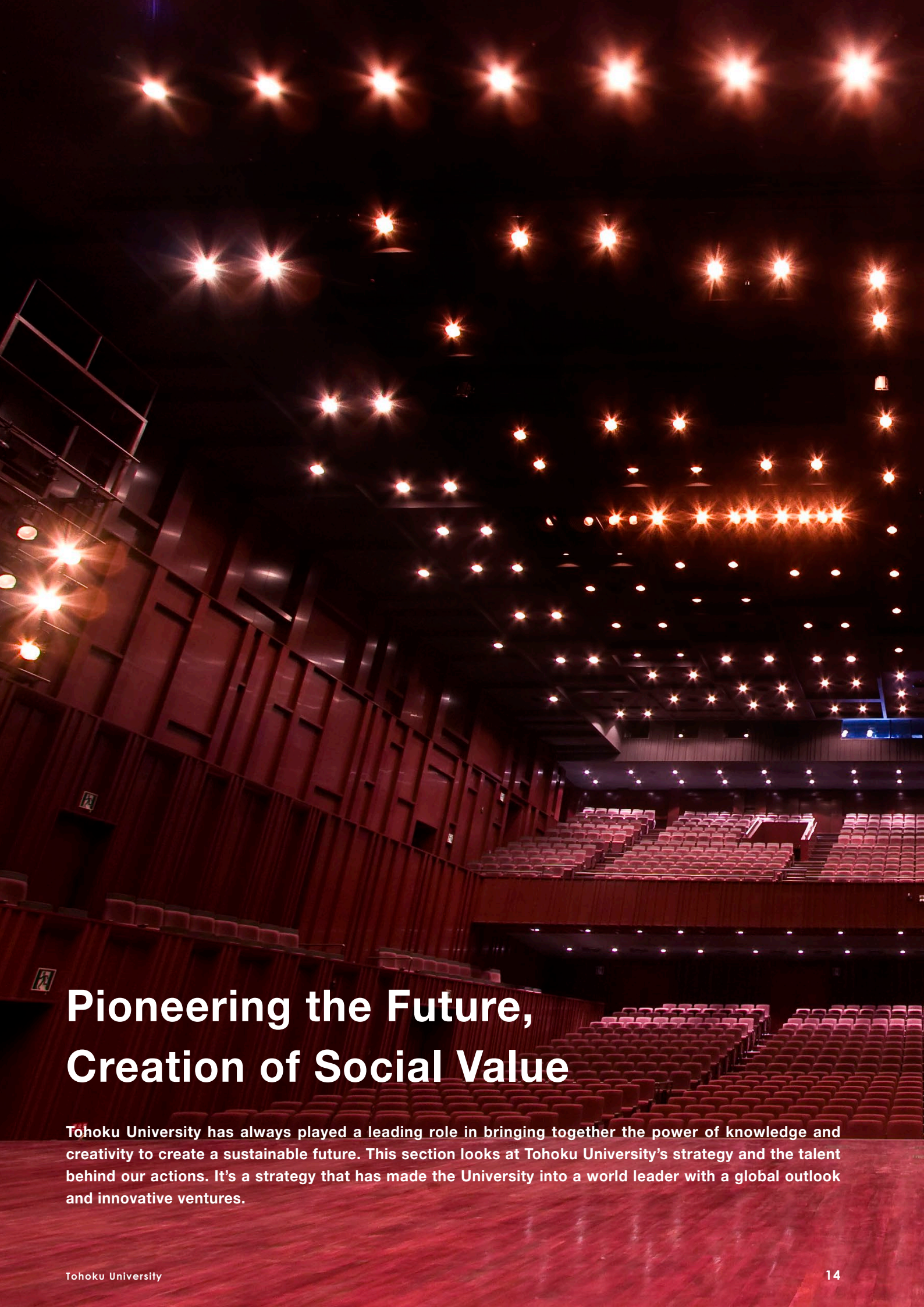
The year 2023 marked the 110th anniversary of the first female students (the 100th anniversary of the first female humanities students), and Homecoming Day theme was "Open Doors: Diversity at Tohoku University." It was an opportunity to reflect on the University's Open Doors principle, as the first university in Japan to admit female students, and on the events leading up to their admittance, as well as an opportunity to look to the future, in light of the history of diversity at Tohoku University.

The commemorative lectures included introductions of the lives of Chika Kuroda, Raku Makita, and Ume Tange––the first three female university students in Japan––as well as discussions in which their family members and other researchers relayed a variety of anecdotes about the three, providing an opportunity to consider their significance and achievements.

The University will also pursue various other related projects, including updating the special webpage on the first female students, setting up a special site commemorating the 110th anniversary, and designing a 110th anniversary commemorative logo.

By widely publicizing and developing activities commemorating the 110th anniversary of the first female students among faculty and staff members as well as among other officials (alumni, current students, the families of current students, etc.) and the general public, we will continue to work together to realize inclusivity and become a world-class research university in which all members can participate with pride.

110th Anniversary of Our First Female Students



Pioneering the Future, Creation of Social Value

Tohoku University has always played a leading role in bringing together the power of knowledge and creativity to create a sustainable future. This section looks at Tohoku University's strategy and the talent behind our actions. It's a strategy that has made the University into a world leader with a global outlook and innovative ventures.

Promoting green growth through open innovation

Tomonaga Okabe (Director of the Research Center for Green X-Tech)

The Research Center for Green X-Tech (Cross-Tech) was established in January 2023. Director Tomonaga Okabe, has a background in research and development for the carbon fiber-reinforced plastics used in aircraft.

He says, “Green is a keyword encompassing the concepts of carbon neutrality (the carbon cycle) and circular economies. Carbon neutrality is about the steps taken to reduce CO2, while circular economies are models used to create resources from the products and materials we once discarded. Sustainability is a concept related to circular economies. But while sustainability is a social issue, circular economies, which started to enter the spotlight around 2020, are focused more on financial factors. The recent discussion of circular economies shows a clear shift in the world’s focus away from work on the environment and toward business growth.”

The ability to achieve green growth in response to tougher environmental regulations in Europe and around the world has become an important issue for the corporate world. But it’s not a struggle that companies can win on their own. The Research Center for Green X-Tech was created by Tohoku University as a venue for partnerships among industry, academia and government. Its aim is to bring advanced digital technology together with real-world manufacturing (a combination known as cross-tech), through open innovation and teamwork among a wide range of companies and research institutes.

The Center is located in a science park next to NanoTerasu, a 3GeV-class high-brilliance synchrotron radiation facility that will start operating in FY2024. The Center is one of the largest of its kind among Japanese national universities. It contains cutting-edge facilities and equipment such as the AOBA supercomputer, a large-scale scientific computing system. The Center hosts co-creation research done by a consortium of about 30 major companies having the overwhelming advantage of being able to bring together front-line researchers with experience in acquiring major research funds. Consortium members represent industries such as materials, chemicals, heavy industry, vehicles and IT.

The research departments are led by the Department of Soft and Functional Materials Research, an area in which Okabe specializes. To bring applied research together with practical research, practitioners from the corporate world have been recruited to serve as Chief Technical Advisors (CTAs). Research division heads of major manufacturers have also been asked to take part. Determining how to analyze data from NanoTerasu and apply it to product development is the key to becoming more competitive. Creating advances in the digital transformation technology used for research is also an urgent issue. NanoTerasu is providing help in this area.

Says Okabe, “Industry, academia and the government work as a vertically integrated system in Japan—they have a top-down structure. This structure has been a limiting factor in keeping pace with global trends while becoming more competitive on the world stage. Needless to say, just leaving industry, government and academia to each work on its own would prevent us from being able to keep pace with today’s radical changes. Far from being competitive, we’d just become an isolated branch of alternative evolutionary development—what we call the Galapagos effect. Western countries foster agile startups by forming strong business groups with members representing industry, academia and government. The Center is imitating this model to create an environment for open innovation that brings cutting-edge research together with technological innovation while using laws and regulations as business tools. The key is to set and work toward goals driven by social implementation instead of just starting with the product you want to manufacture. Our goal is to augment Japan’s industrial sector, which will lead to future prosperity. I’m confident that the Center will be the lubricant that greases the wheels of reform in Japan’s industrial structure.”

The world is now moving toward circular economies. Open innovation provided through industry collaboration is essential for enhancing technology development and productivity to keep pace with the changing times.
Located in Tohoku University's Science Park,
the Research Center for Green X-Tech (Cross-Tech) brings cutting-edge research together with technological innovation.

Current state & issues

Changing corporate attitudes toward green innovation activities

- Green growth is an important issue for companies
- Coming up with solutions by individual companies alone is impossible

University and companies are working on green growth by forming new research complex (organization to bridge innovation gap)

Strategy

Research Center for Green X-Tech

A site for innovation through industry collaboration, aiming to provide solutions to green-related business issues and social issues. It uses practical scientific research that brings together science, engineering, data science, IT and other advanced technologies.

Advantage 1

One of largest science parks of any Japanese national university

(see details on next page)

Advantage 2

NanoTerasu and other advanced on-campus facilities

(see details on next page)

Advantage 3

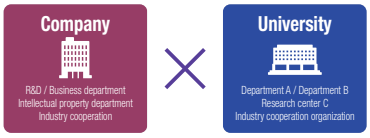
Bringing together researchers with experience in acquiring major fundamental research project funds

- Provides venue for open science
- Researchers with experience in advanced research and industry cooperation are recruited from inside and outside University
- Private joint research cost of over JPY 7 million per project (for engineering projects; third highest in Japan)

Advantage 4

Co-creation Research Centers

Number of Co-creation Research Centers created: 17
(as of July 2023)



- Creation of company activity center on campus
- Representatives from participating companies are appointed as General Managers
- Scope extending to all University departments
- Investigating fundamental research topics and other comprehensive activities for industry collaboration

Advantage 5

Creating startup ecosystem

- Tohoku University Startup Garage (TUSG)
- Assistance with business feasibility verification (BIP, Michinoku Gap Fund)
- Startup investment by Tohoku University Venture Partners Co., Ltd.

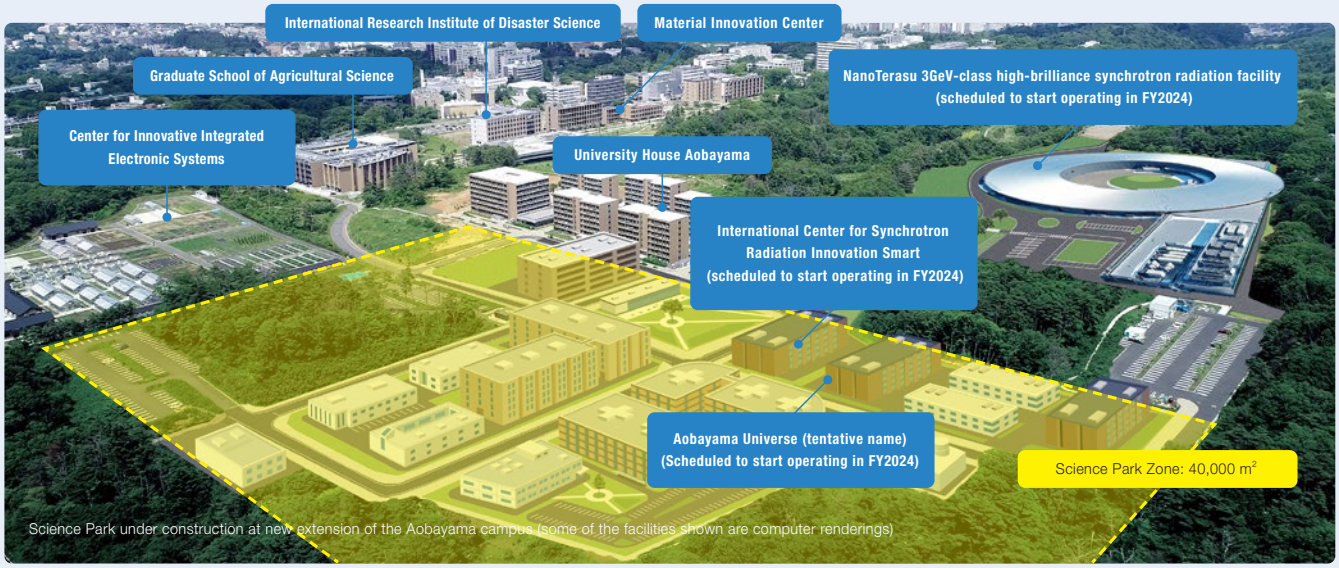
Tohoku University Science Park Project

Tohoku University Science Park is a hub for co-creating social value where diverse participants such as industry, academia, government and finance (private companies, universities, communities, and financial institutions) gather and unite. The west side of the NanoTerasu 3GeV-class high-brilliance synchrotron radiation facility located in the new extension of the Aobayama campus is currently home to a 40,000 square meter plot designated as the Science Park Zone. It contains the research wing of the International Center for Synchrotron Radiation Innovation Smart, along with Aobayama Universe (tentative name). The latter functions as a facility for open innovation, incubation and joint research with the private sector. Both facilities are scheduled to begin operation in FY2024. The Science Park Zone will take the lead in stepping up the pace of projects by private-public co-creation. These projects will promote green transformation throughout a number of different industries in areas such as semiconductors, drug discovery and food processing. They will be made possible by digital transformation for research that brings together measurement and computing in areas extending from analysis of big data obtained from cutting-edge equipment owned by NanoTerasu and the University, to modeling and simulations.

By providing a new site for an industry cooperation, the Seiryo Campus will step up the pace of projects for community co-creation. It brings together a number of facilities providing unique cutting-edge life science research functions. Examples include several medical graduate schools and research institutes, the University hospital that stores clinical data for over 900,000 subjects, and the hospital's translational research unit CRIETO (Clinical Research, Innovation and Education Center, Tohoku University Hospital). It is also home to the Research Center for Pharmaceutical Development, along with the Tohoku Medical Megabank Organization (ToMMo; one of Japan's largest population-based biobanks).

The Tohoku University Co-Creation Initiative, Inc. is a subsidiary created in April 2023 through joint investment with Sumitomo Mitsui Trust Bank. Working on a number of new growth schemes for the University, the Initiative is expected to produce the sort of significant real-world impacts that would be unattainable by the University alone. Examples of its activities include consulting work on areas such as creating business plans for collaborations with the Science Park Project.

Seeking to become a collaborative platform for creating new knowledge and disruptive innovation, the Science Park Project will work steadily to create a global open innovation ecosystem by using the University's superior knowledge as a foundation for bringing creation of social value.



Science Park under construction at new extension of the Aobayama campus (some of the facilities shown are computer renderings)

TOPICS

Tohoku University Co-Creation Initiative, Inc. First subsidiary created from joint investment by Japanese national university and private sector

THCI Tohoku University Co-creation Initiative

Created by the University in April 2023, the Tohoku University Co-Creation Initiative, Inc. is the first subsidiary to emerge from joint investment by a Japanese national university and a private-sector company (Sumitomo Mitsui Trust Bank). Working on new growth schemes for the University in collaboration with the Science Park, the Initiative will aim for the sort of significant real-world impacts that would be unattainable by the University alone. Incorporating talented human resources and business skills of a private company, the Initiative will enhance functions designed through the Tohoku University Co-Creation Initiative, Inc. to help private companies make use of the University and University research findings for business applications. Its aims are to step up the pace of innovation driven by digital transformation, to work on ongoing project development through partnerships and joint ventures with project companies, and to aim for social implementation using startups and financing.

TOPICS

The NanoTerasu Logo

The NanoTerasu logo was officially unveiled on May 11, 2023. Selected from among entries submitted by the public, the design is intended to evoke the concepts of creation, science and the future. It depicts a beam of synchrotron radiation combined with the shape of the NanoTerasu facility.

G7 Science and Technology Ministers' High-Level Meeting in Sendai "Quantum Innovation for a Better Future" held at NanoTerasu

NanoTerasu served as the venue for the high-level meeting hosted by the University and the Quantum STrategic industry Alliance for Revolution (Q-STAR). Held to discuss the "Quantum Innovation for a Better Future", the gathering was an official side event co-hosted by the Cabinet Office, MEXT and METI. It was held on the final day of the G7 Science and Technology Ministers' Meeting in Sendai that ran from May 12 to May 14, 2023. The gathering gave top government officials and industry groups from around the world the chance to share their views on the work being done to step up the pace of social implementation of quantum technology and the challenges ahead.

NanoTerasu 3GeV-class high-brilliance synchrotron radiation facility

NanoTerasu has been created on the new extension of the University's Aobayama campus through a regional private-public partnership that is the first of its kind in Japan. It is scheduled to come online in FY2023 and begin operating in FY2024.

NanoTerasu is essentially a giant microscope that uses light (synchrotron radiation) over a billion times brighter than the sun to observe the nanoscale world (on a scale of nanometers, billionths of a meter).

It incorporates cutting-edge Japanese accelerator technology and light source technology, generating data (visual representations) that make it possible to see a world that was once invisible.

NanoTerasu should help provide solutions to social issues such as achieving carbon neutrality and fighting infectious disease. It should also prove useful for the academic use in material and life sciences, as well as for bio-related areas, food ingredients, semiconductor materials and other industrial applications.

It will be a powerful tool for creating innovations of benefit to the project members who have come together at the University's Science Park, as well as to the Tohoku region and Japan as a whole.

Working as a member of a regional partnership among participants from the public and private sectors, the University will harness its knowledge to analyze measurement results and data generated by NanoTerasu to provide high-value services to the industrial sector and other users. An innovation ecosystem designed to solve problems and bring different disciplines together will be created by using the University as a focal point and involving a wide range of participants from the industry, academia, government and finance.

This work will see the use of NanoTerasu come to play a pioneering and leadership role both for scientific applications and for industry cooperation. It will help fundamentally enhance the level of Japan's research.

Forward-looking Tohoku University Sustainability Bond issue enables autonomous university management while bringing creation of new social value

Bond profile

Name	First Bonds of National University Corporation Tohoku University (A sustainability bond known informally as the Tohoku University Future-Creation Bond)
Maturity period	40 years
Amount of issue	JPY 10 billion
Interest rate	1.879% per year
Date of issue	February 3, 2023 (Fri)
Redemption date	March 17, 2062 (Fri)
Ratings	Rating and Investment Information, Inc. (R&I) rating: AA+ Japan Credit Rating Agency, Ltd. (JCR) rating: AAA
Sustainability bond framework scores*	Overall score: SU1 (F)
	Green and social issues score (use of funds): gs1 (F)
	Management, administration and transparency score: m1 (F)

*There are 5 levels for each score. From highest to lowest, the levels are: SU1 (F) to SU5 (F), gs1 (F) to gs5 (F), and m1 (F) to m5 (F).

Features

- **Issued as a sustainability bond (SDG bond) that combines social and green characteristics, and helps achieve SDG Goals 4, 7, 9 and 11**
- **Investment in a project designed to function as an ever-developing public role by helping achieve the green future society, while bringing creation of new social value as a way to solve global issues of public concern.**

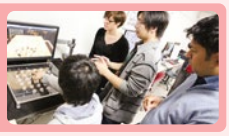
Use of funds

The funds raised from the University's bond issue will be used for projects providing innovation platforms designed to create a green future as outlined by Tohoku University Vision 2030 and Tohoku University Connected University Strategy.

Innovation platforms creating a green future

Hub for Talent Development

Providing cutting-edge educational environments to train global leaders and entrepreneurs



Hub for Research Excellence

Providing world-class research environments, pioneering new areas of science and producing outstanding research findings

Hub for Strategic Growth

Providing cutting-edge sites for industry cooperation, stepping up the pace of collaboration with the community, and achieving an open innovation ecosystem

The facilities provided will be green buildings designed to achieve carbon neutrality by FY2040 as outlined in the Tohoku University Green Goals Initiative

Tohoku University is a world's leading university in helping find solutions to the issues of public concern that are facing humanity worldwide

The Tohoku University Sustainability Bond is the University's first bond issue, with a maturity period of 40 years and the issue amount of JPY 10 billion.
It's a sustainability bond that invests in projects designed to support the creation of new social value as a way to solve global issues of public concern. It will create a virtuous cycle by expanding the University's educational and research activities while generating autonomous business growth.

Interest in the Tohoku University Sustainability Bond

Some of the biggest Japanese national university investors (152 investors representing 86 organizations) have taken part in the University's Investor Relations (IR) events

Tohoku University has organized strategic IR events to raise awareness of the University's activities. Along with one-on-one IR meetings and group IR events, they include the first-ever campus tours given to investors by a Japanese national university. These events have been attended by some of the biggest Japanese national university investors, demonstrating the high level of interest in the University.

[Campus Tours for Investors]

For the first time at a Japanese national university, investors have been invited to take part in University campus tours, giving them a first-hand look at the major facilities. To more effectively communicate the University bond issue's selling points through discussion with investors, University President Hideo Ohno has appeared in person to describe how the bond is making a difference.

かんぽ生命

[Investor Feedback]

"Most of the information I get is from online sources. I don't get a lot of opportunities for a hands-on look at the people and things we invest in. So, getting to meet real people working hard on research topics at real University facilities was a terrific experience. I want to keep a close eye on what Tohoku University does in the future—things like getting more women into the workplace and building NanoTerasu. I'm looking forward to seeing more of your proactive information disclosures." (Naoko Itaya, Japan Post Insurance Co.,Ltd.)

[Video of President Ohno's Message]

A video of a message delivered by President Ohno was created and released as a more inventive way to deliver IR information with visual appeal.

A message to potential investors from Tohoku University President Hideo Ohno
https://www.tohoku.ac.jp/japanese/disclosure/disclosure/11/disclosure1101/

Financial market assessment

- **The University's bond issue is unique in having attracted eager participation from regional investors in addition to the life insurance companies and other central investors who are the principal purchasers of 40-year university bonds.**
- **University bonds are well known investment products with steady sales. Companies supportive of Tohoku University's work on SDGs have taken part.**

(Sources: Capital Eye News, Finance Facsimile News)

Demand factor	3.16 (JPY 31.6 billion / JPY 10 billion)
Number of corporate investors	22 (11 central, 11 regional)

Using university bonds to help provide solutions to global issues and grow green projects

Yasuhiro Miyata (Executive Vice President for Fundraising and Investment Management)

University bonds are bonds that universities issue to raise funds to acquire land or provide facilities for cutting-edge education or research. Augmenting education and research environments are essential for universities that want to be able to attract the most talented human resources or do high-level R&D. Being able to raise and manage funds rapidly has become key for sound university management, and is a trend that has emerged worldwide. With an amendment to the Enforcement Order of Japan's National University Corporation Act making a greater range of businesses eligible for university bond issues, Tohoku University issued a 40-year bond named the Tohoku University Sustainability Bond (First Bonds of National University Corporation Tohoku University) in February 2023. The issue amount is JPY 10 billion. The bonds are also sustainability bonds that apply the raised funds to projects providing innovation platforms designed to create a green future. These projects aims to bring creation of new social value as a way to solve global issues of public concern such as SDGs and carbon neutrality.

The University's first bond issue was led by Executive Vice President Yasuhiro Miyata. Miyata is a strategist with extensive expertise in global economic trends and financial markets. His career experience includes Chief General Manager of Investment at Dai-Ichi Life Insurance, where he also served as Director of the Equity Investment Department and Managing Executive Officer. He says, "University bonds are common in the US, where JPY 2 to 3 trillion worth is issued every year. But the cumulative total in Japan still only amounts to about JPY 130 billion, issued by Tohoku University and five other national universities. Tohoku University is geographically distant from the capital markets of the Tokyo area, giving us little in-person contact with investors. So, creating relationships was a major issue for us. That meant holding discussions with investors as a way to highlight the University's strengths and generate interest."

Campus tours were given to investors in December 2022 as part of the IR events held to raise awareness of the University's advanced education and research environment. Investors were shown the International Research Institute of Disaster

Science, the Center for Innovative Integrated Electronic Systems, the NanoTerasu 3GeV-class high-brilliance synchrotron radiation facility, and Aobayama Garage (the Tohoku University Startup Incubation Center).

Miyata says, "Our campus tours gave investors the opportunity to view our facilities first-hand. The tours were the first of their kind for a Japanese national university. A total of 152 investors from 86 organizations took part in our IR events. That's a higher level of engagement than you'll find at other universities. Investors got the chance to see our world-class cutting-edge research environment and large-scale equipment for the first time. Our President, Hideo Ohno also delivered a speech in person on how the University's bond issue is making a difference. These things left a major impression, giving many investors a clear sense of the University's role as a repository of valuable knowledge and technology for shaping the future. Twenty-two companies have invested in the bonds. Demand has risen to JPY 31.6 billion, which is a lot more than the issue amount. The bonds have been rated highly by investment professionals. The response we've gotten will lead to donations, joint research and new life for startups."

The bond's 40-year life span is the longest maturity period defined in the Enforcement Order of the National University Corporation Act. During this period, we are looking to diversify our investor base and hold ongoing discussions with investors to improve their understanding and appreciation of the University. With half of our investors located in the local Sendai area and other outlying regions, we want to solidify our identity as a university engaged with society by enhancing our engagement with regional communities.

Increasingly diverse methods of fundraising through financial markets will lead to a growing range of education and research activities funded partly by the private sector. Attracting new investment and refining university management will be other areas of focus. Boosting investment returns by enhancing fund management functions will augment flexible funding and ensure governance flexibility while further adding to the virtuous cycle of funding. It will also help grow green projects and provide solutions to global issues such as SDGs and carbon neutrality through partnerships that bring private-public collaboration.

Tohoku University Vision 2030

With the modern society undergoing a period of major upheaval, universities will be playing a key role in dealing with worsening environmental problems, poverty and other global issues that are difficult to predict. Tohoku University has responded to this environment by creating a list of future challenges that need to be addressed to meet the goals of the University's core mission. This list was released in 2018 as Tohoku University Vision 2030. In 2020, Tohoku University Vision 2030 was updated with the creation of the Connected University Strategy—a blueprint for stepping up the pace of the University's transformation adapted to the post-pandemic 'new normal' era. Guided by this vision, the University's bond issue is being used as a chance to work on building a new future as an ever-developing public role.

Creating cutting-edge innovations, taking on the challenges of major reform

1 Education	Creating educational programs that foster student ambition and maximize student creativity as a way to train leaders who can guide a radically changing world with confidence and a global outlook
2 Research	Consolidating our position as a general research university deserving of a Top 30 worldwide university ranking by generating new knowledge through superior scientific research and working tirelessly to pioneer new areas of science and produce innovations
3 Community co-creation	Embracing our role as a university engaged with society by partnering with a number of different sectors to bring creation of new social value and pioneer reforms paving the way for the future
4 Governance reforms	Reforming university management to create a virtuous cycle of growth alongside the community, underpinned by a foundation of superior education and research
Connected University Strategy	Adapting to the 'new normal' by working tirelessly on education, research, community co-creation, and bringing all work online, while also augmenting University activities and stepping up the pace of progress on Vision 2030 by using cyberspace together with real-world spaces

Convergence Knowledge: A wealth of world-class knowledge brought together at Tohoku University

Convergence Knowledge is the key to enabling dynamic growth of science and technology. Bringing together a wide range of knowledge from specific perspectives creates new value and reinvigorates the knowledge base. The Sustainability Open Knowledge-Action Platform (SOKAP) is an open platform created by Tohoku University to assist world-class pioneering research and help achieve sustainability through collaboration with a wide range of stakeholders.

Exploring the Convergence Knowledge
01

[Expected Social Effects]

- Promoting interdisciplinary research, creating new value
- Training the next generation of researchers personifying the Convergence Knowledge
- Applying knowledge to behavior to help bring joy to the world

Motoko Kotani

(Executive Vice President for Research)

The global spread of the COVID-19 pandemic underscored the close relationship that science and technology have with society. The pandemic created a keen awareness of just how much science and technology can impact people in the modern world. Populations worldwide were quick to become vaccinated during the pandemic as vaccines were released alongside the spread of the virus. The same was true even for people who had never felt personally at risk from news of the threats to mankind posed by climate change and the energy crisis.

Motoko Kotani underscores the impact of science and technology: "Humans have expanded their horizons by using science and technology to make previously impossible things possible. The challenges facing the modern society are global issues. They can't be solved by just a single country or research discipline alone. And cutting-edge research is now being turned into social implementation very quickly. That's rapidly bringing the general public closer to science and technology. I mean, it was only until recently that quantum computers and artificial intelligence (AI) were considered cutting-edge research. Now they've already begun to change the world.

"The march of science and technology has human happiness as its end goal. A key concept here is Convergence Knowledge. It's a term that means supplementing the perspective of the natural sciences with the perspectives of the humanities and social sciences, or vice-versa. The development of generative artificial intelligence is one area where it's important, since that's an area that always involves different elements like ethical and laws and regulations. It's this sort of diversity that makes science dynamic. It's important to get experts from a broad range of disciplines to discuss the impacts and possible outcomes of social change. Working with the wider world to shape this discussion is a role that academia should play."

But achieving a cross-disciplinary Convergence Knowledge also involves some challenges. Kotani says, "Besides mastering their individual areas of expertise, the next generation of researchers is going to have to refine their ability to think flexibly when interacting with the general public, government officials or other stakeholders. We need to think about the type of training that will be needed to produce proficiency across multiple research areas, countries and cultures. Approaches to talent development are becoming a worldwide discussion."

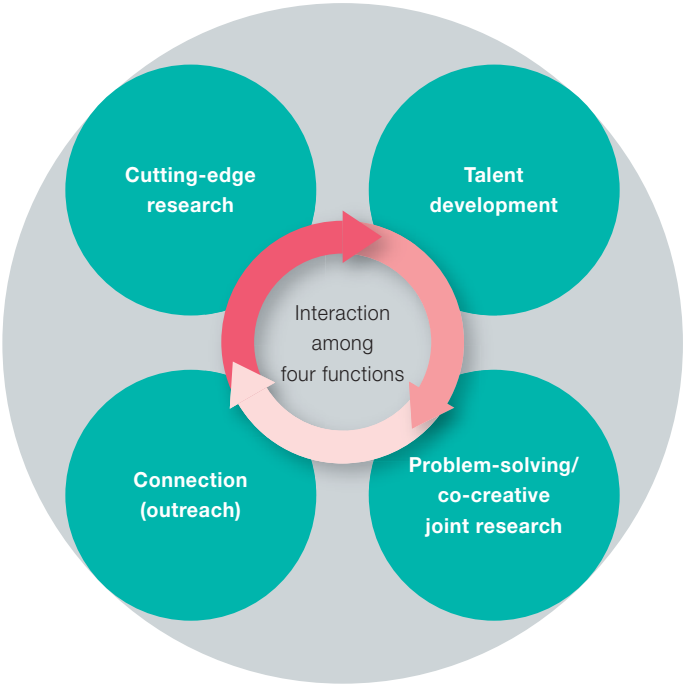
The experience of living through a crisis felt by researchers around the world during the pandemic had already been experienced by Tohoku University researchers in 2011 during the Great East Japan Earthquake. The disaster gave them a better sense of their relationship with the community, forcing them to reconsider what it means to be a researcher, how to address the challenges of the disaster zone, and how their research could help rebuild the community.

The University has now created a campus environment that lets researchers put a greater awareness of global sustainability into their work. Examples of sustainability-oriented research include research projects selected for the Cabinet Office's Moonshot Research and Development Program, along with the Frontier Research Institute of Interdisciplinary Sciences (a unique initiative that promotes interdisciplinary interaction among young researchers). The Sustainability Open Knowledge-Action Platform (SOKAP) is a venue now under construction for enhancing the Convergence Knowledge. It will be used to create knowledge that connects with the real world in an open and actionable way that transcends the framework of the University.

The researchers working with SOKAP are profiled starting on the next page. Says Kotani, "The SOKAP researchers all represent Tohoku University. So, I hope the world will view their research endeavors as precisely the sorts of things that Tohoku University wants to make happen to bring about sustainability."

Sustainability Open Knowledge-Action Platform (SOKAP)

The Sustainability Open Knowledge-Action Platform (SOKAP) is a sustainability-oriented platform being created by the University. It has four functions: Cutting-edge research, talent development, problem-solving/co-creative joint research, and connections (outreach).
It will bring together a wide range of researchers from inside and outside the University who will work on the common theme of sustainability. It will be an unprecedented research venue that provides a mechanism for taking knowledge generated from research and connecting it to action. It will assist in the search for solutions to global issues by enabling collaboration among a broad range of stakeholders.



Resource Supply Chains as viewed through the lens of Environmental and Resource Economics and the law of the sea

The radical changes now taking place in the structure of industry has not diminished the utility of mineral resources. In fact, technological innovations have only increased the demand for some minerals.With countries starting to take an interest in the world's unexplored oceans and especially the ocean depths that represent the planet's last frontier, this section looks at sustainability through the lens of Environmental and Resource Economics and the law of the sea.

Exploring the Convergence Knowledge 02

[Expected Social Effects]

- **Quantifying resource circulation, creating a radical shift toward sustainability awareness**
- **Finding solutions for marine ecosystem protection and other global environmental issues**
- **Closing the worldwide gap between rich and poor**

Kazuyo Matsubae (Professor, Graduate School of Environmental Studies / Director, Institute for Resource Initiatives)

Kentaro Nishimoto (Professor, Graduate School of Law / Vice-Director, Center for International Law and Policy)

Nishimoto: I specialize in international law, which governs the relationships among states. My research focuses on the law of the sea. Your work in Environmental and Resource Economics is an interesting area of research from a law of the sea perspective.

Matsubae: Yes, after majoring in economics in undergraduate and graduate school, I did a master's degree on labor adjustment and then a PhD on waste generation and resource recycling. I got the position of Assistant Professor at the Department of Materials Science and Engineering in Tohoku University's School of Engineering through a connection. Since starting in this position, I've been researching the supply chains of metal resources such as iron, aluminum and copper. I study the environmental impacts of resource flows. I use a cross-disciplinary approach that combines economics and engineering to study the environmental issues and other social issues being caused by resource use. Issues are described in terms of lifecycle assessments used to quantitatively assess the environmental impacts of products and services. My work has attracted a lot of interest in marine resources in the broad sense of the term that includes minerals and marine products.

Nishimoto: That relates to my area of expertise, which is the law of the sea. It's an area that primarily deals with how the authority to use the sea is allocated between states. It dates back to the so-called "battle of the books" in the early 1600s, when the right of states to own the seas was debated. Before joining Tohoku University, I was part of an interdisciplinary program that bring together diverse areas ranging from law to shipbuilding technology and marine biology. That experience made me realize the importance of interconnections among different disciplines in research. I've also been involved in the process of making law, serving as an advisor to the Ministry of

Center for International Law and Policy

The Center for International Law and Policy (CILP) was created in April 2023 to strengthen the development of talents and policy recommendations relating to international law. As one of only a few institutions that have sent judges to the International Court of Justice, International Tribunal for the Law of the Sea, and International Criminal Court, Tohoku University aims to contribute to the development of international rules and standards by drawing on a Convergence Knowledge in the humanities and social sciences.

https://cilp.oii.tohoku.ac.jp/english/

As a way to help create environmentally friendly supply chains of high added value, Matsubae studies the areas of environmental and public responsibility involved in the use of resources through supply chains. She also serves as the project leader for an organization promoting science and technology entitled the Program on Open Innovation Platforms for Industry Co-Creation (COI-NEXT).

Foreign Affairs for the negotiations of a treaty adopted by the UN in June 2023 to protect biodiversity on the high sea and the deep seabed.

Matsubae: The deep sea and polar regions are the frontiers of mineral development. There are abundant deep sea reserves of manganese, for example. But working in the deep ocean requires collaboration with other disciplines. Ownership of seafloor resources is also a difficult issue to deal with.

Nishimoto: Yes, and some experts say that the high pressure of the deep sea makes it more difficult to reach than even outer space. Countries are starting to develop seafloor minerals, and issues related to sustainability are being discussed internationally. There is an understanding that precautionary restraints should be placed on development even when there is scientifically uncertainly concerning the environmental impacts. At the same time, there are expectations that deep seabed mining could provide minerals that are essential for things like renewable energy technologies. I feel we need to work on this issue with an interdisciplinary approach that brings a variety of fields together.

Matsubae: Exactly. Right now, I'm leading a COI-NEXT project called, "Green Job Market Fostering a Co-Creation Base Based on Gastronomy Geopolitics." COI-NEXT is a program designed to help form venues for collaboration. My project is joint research designed to help ensure sustainable food supply chains compatible with local environments and economies while adapting to climate change. The project has made me realize just how difficult it is to get measurement data to give us an understanding of marine ecosystems. I mean, being able to quantify and visually depict data is really important for any discipline.

Collaboration among industry, academia, and government to form local sites for autonomous and sustainable gastronomy geopolitics

Matsubae heads a project called, "Green Job Market Fostering a Co-Creation Base Based on Gastronomy Geopolitics." It seeks to refine the concept of gastronomy while raising awareness and understanding of the natural ecosystems that put food on the table. The project is working to create ecosystem management and preservation technologies, transform food supply chains into environmentally aware models, and encourage environmentally aware consumer behavior.

Historic BBNJ agreement to protect marine biodiversity on the high sea

Nishimoto was involved in the negotiations for the marine Biological diversity of areas Beyond National Jurisdiction(BBNJ) agreement by serving as an advisor to the Japanese delegation. The agreement is a new international agreement for the conservation and sustainable use of biodiversity on the high sea worldwide. It was adopted at the UN in June 2023 after about 20 years of discussion. It promises to be a step forward in protecting biodiversity on the high sea, where no comprehensive set of rules protecting rare species and ecosystems previously existed.

Nishimoto: Very interesting. I had an opportunity to visit a site that recycles plastic waste into pallets used by the logistics industry. It was for a class at the Graduate School of Public Policy where students work together to create policy recommendations. The topic was the problem of marine plastic pollution. I think environmental problems need to be seen and experienced by everyone first-hand to turn them into something personal. That's a crucial requirement for solving them. One job of academia should be to show the world how environmental problems are structured—things like how our lives are connected to marine environments, for example.

Matsubae: Yes, and did you know that most of the plastic in the ocean comes from just seven of the world's rivers? That's another good example. Most of these river basins are in developing countries, so figuring out how to work with developing countries is the key to the global plastic waste problem. Mineral resources from the land also have problems of their own. Mining not only impacts natural capital by disturbing ecosystems and polluting water, it also creates the risk of cultural asset destruction and human rights violations such as exploitative wages and child labor. What I want to do is bring transparency to the wide range of environmental and public risks associated with resource use, so that proper yardsticks can be created and used in technology development. The goal is ultimately to get rid of the distortions you get when resources are allocated through supply chains.

Nishimoto: I see. From my perspective, there is a legal or institutional aspect to any kind of societal issue, including the protection of the environment. However, legal experts are not necessarily experts on the particular issue being dealt with. From a legal standpoint, the question to ask is, what laws should be put in place to implement a measure that is designed to solve a problem in the real world? To discover a problem, identify its mechanism, and then create a solution, knowledge from a number of different disciplines such as economics and engineering, is reqquired. So, experts with interdisciplinary expertise and the Convergence Knowledge approach are likely going to become increasingly important.

Nishimoto specializes in international law, which governs the relationships between states. Outside of the University, he is working on a large research project at the National Institute of Polar Research as the first faculty member with a social sciences background. He has also served as an advisor in international treaty negotiations. His expertise and research have been applied extensively to international issues.

Prospect for the cutting-edge science to support future lifestyles

The Moonshot Research and Development Program is a project being led by the Cabinet Office as a way to find solutions to difficult social issues. Two project Managers who are challenging cutting-edge science to enrich the future discuss their vision and the society they envision. The Program is breaking new ground by bringing challenging new ideas together with cross-disciplinary knowledge.

Exploring the Convergence Knowledge 03

[Expected Social Effects]

- **Social participation of all people supported by AI robots**
- **Community-wide assistance for childcare**
- **Realization of an inclusive society**

Yasuhisa Hirata (Professor, Graduate School of Engineering)
Chihiro Hosoda (Associate Professor, Graduate School of Information Sciences)

Hirata: Let me introduce myself and talk about our research. The title of our moonshot project is “Adaptable AI-enabled Robots to Create a Vibrant Society.” We are mainly working on research and development of nursing care robot under the theme of “Robots that accompany and support people's lives.” Our project is to construct a technology to coordinate multiple AI robots with limited functions to assist with various physical activities such as getting up from bed, walking, going to the bathroom, etc. in an optimal way according to the disability of the individual, rather than a single humanoid robot that takes the role of a human caregiver. Even if they do not look humanoid, if they have sensors, actuators to operate mechanisms, and controllers to control them, they are robots. Our goal is to support people who need care by having multiple robots with different functions work together and change the form of support. In addition, the key point is to provide not only physical support, but also mental support by arousing

Moonshot Research and Development Program

A large R&D program aiming to create Japanese disruptive innovations that will help provide solutions to key issues of the future. The program has set 9 concrete goals in 3 areas: Society, environment and economy.

Society Providing groundbreaking innovations to pioneer an era of declining birthrates and aging populations
Economy Exploring new frontiers of science and technology
Environment Refining urban civilization while healing the global environment

Goal	Society	Environment	Economy
1 Realization of a society in which human beings can be free from limitations of body, brain, space, and time by 2050.	★		
2 Realization of ultra-early disease prediction and intervention by 2050.	★		★
3 Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.	★		★
4 Realization of sustainable resource circulation to recover the global environment by 2050.		★	
5 Creation of the industry that enables sustainable global food supply by exploiting unused biological resources by 2050.		★	
6 Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.			★
7 Realization of sustainable care systems to overcome major diseases by 2040, for enjoying one's life with relief and release from health concerns until 100 years old.	★		
8 Realization of a society safe from the threat of extreme winds and rains by controlling and modifying the weather by 2050.		★	★
9 Realization of a mentally healthy and dynamic society by increasing peace of mind and vitality by 2050.	★		★

Hirata has been researching distributed cooperative control systems for multiple robots since he was a student. In recent years, he has been involved in research on welfare robots for use in nursing care, believing that cooperative control technology for multiple robots can be used not only in industrial sites and living spaces but also to assist people with disabilities. He is leading a project titled “Adaptable AI-enabled Robots to Create a Vibrant Society.” The project is part of the work being done on the third goal of the Moonshot Program, which is the realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.

https://w3.tohoku.ac.jp/moonshot/en/project_e/hirata_e/

a sense of motivation and accomplishment, such as "I feel safe, can do activities by myself, and want to be able to do more, because of the support by robots”. The goal is to realize a vibrant society where people and robots coexist in harmony and where robots encourage everyone to take on new challenges.

Hosoda: My research is from a neuroscience perspective, with an emphasis on fostering motivation as well as individual traits through education, upbringing and well-being. Learning is about taking on new challenges and acquiring new things throughout life, and my topic is how to approach people to help them achieve what they want in order to be in a state of well-being. For example, we are using information about the brain structure to predict their "persistence" and find the right educational method for each individual. Under the moonshot, the challenge is to build a "well community” that allow us to socialization of parenting. While the problem of uneven parenting has not changed, the environment in which children are raised has changed dramatically. We are exploring a mechanism to clarify the fundamental nature of the problem and to support multi-party child-rearing based on "worthiness" beyond blood relatives, i.e., society..

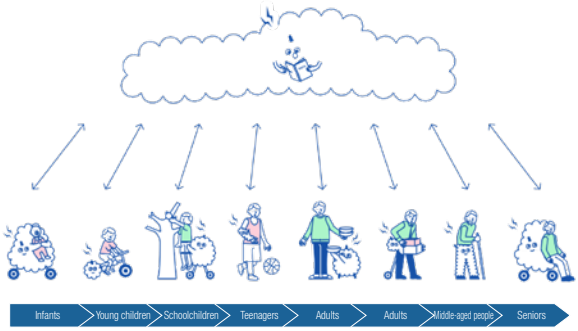
Hirata: In fact, I have a certain concern. Even if a multifunctional robot is developed, it may not be accepted by society. For example, the caregivers may not want to change the nursing care field, saying that the conventional way is better, and the care receivers may not want to be taken care of by robots (machines). In order for people to accept increasingly advanced science and technology in the future, it is necessary not only to build technology but also to foster a society that accepts and trusts robots.

Hosoda: Exactly. We need to think about the problems that technological innovations are designed to solve, and the kind of future that their use will create. People who lack the technical literacy to understand the nature of these innovations will be increasingly frustrated and stressed by them, creating a divide between innovation users and non-users, and between the able and the unable.

Hirata: That’s right. By 2050, various technologies will be developed and people will become more individualized. At the same time, there will be a deepening of inclusiveness, where each individual is respected and can play an active role in society. Able-bodied people inviting a person in a wheelchair to go to a dance event with them is a concept of diversity, but an inclusive society goes beyond that. In other words, we envision a society where people not only participate in dance events but

Vision for 2050 society

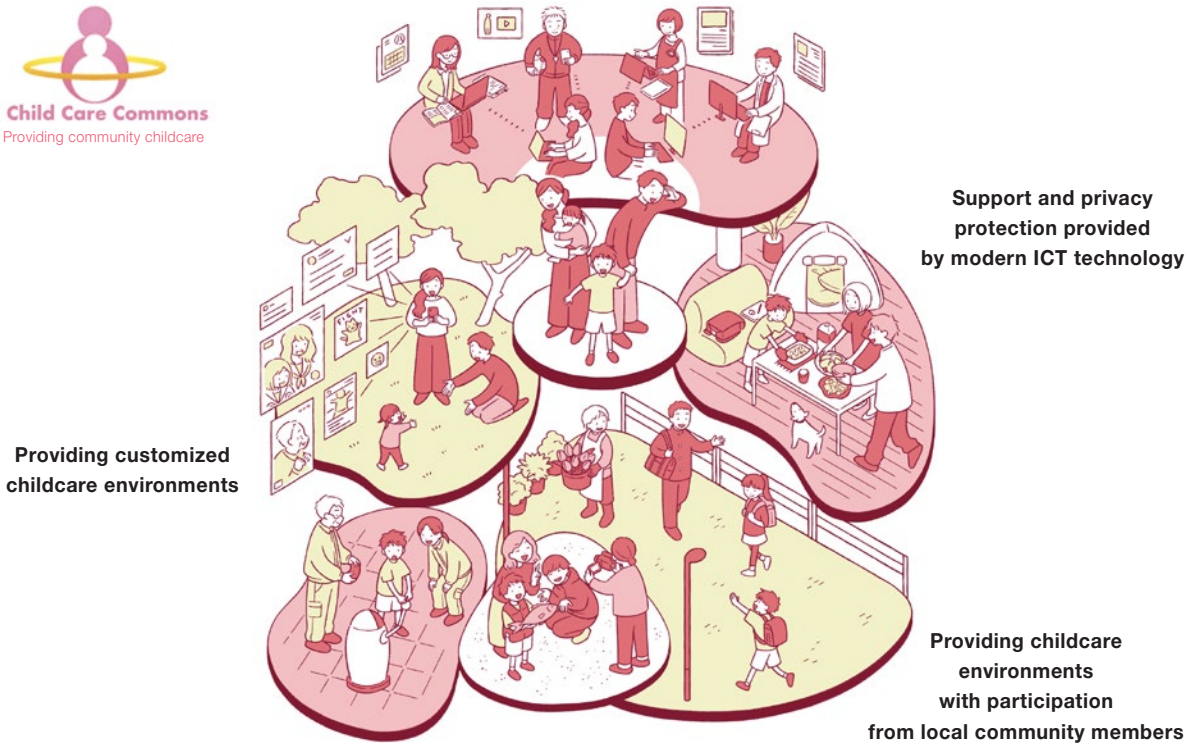
Adaptable AI-enabled robots that accompanies you through life



Providing a wide range of assistance for any area of application

Hirata's goal is to build a vibrant society in which each individual can shine and play an active role, and where the presence of robots makes each individual an asset to society.

Child Care Commons is a project proposed by Hosoda to develop a mechanism for diversifying the ways in which society interacts with child care to enable better child care environments. The aim is to create a future in which child care is a society-wide activity.



also dance together using AI robots. We are also developing dance support robots that actually allow everyone to enjoy dancing.

Hosoda: That's great. But the reality is that things don't always go well for people as individuals. It's not nice to say, but sometimes individuals fail. So, what's important is to aim for community well-being as a collective.

Hirata: To achieve goals, it's essential to have a Convergence Knowledge that brings together the expertise of researchers from several different disciplines who share a common vision. Research and development of nursing care robots cannot be accomplished by us in engineering alone. So, We are collaborating with doctors, caregivers, physical therapists, occupational therapists, etc. . We have also begun collaborating with psychologists to understand human subjectivity, mathematicians to quantify it, and ELSI researchers to ensure that robots are accepted by society.

Hosoda: Yes, research should never be limited to just one discipline. Take me, for example. I started out specializing in second language acquisition, and then moved on to studying areas like brain science, technology and psychology. My research still combines each of these disciplines. So, I've no doubt that the Convergence Knowledge approach is key when you're researching challenging new ideas.

Hosoda studies the way in which individual differences in cognitive functions, non-cognitive functions (such as perseverance) and well-being relate to individual differences in brain structure and functional networks. She wants to develop a system that will enable well-being by using objective quantitative indicators to shed light on individual characteristics and optimize the use of each individual characteristic. She is Project Manager of the "Child care commons: Proposing social infrastructure allowing others to socialize the child care." It is part of the ninth Moonshot goal, which is the realization of a mentally healthy and dynamic society by increasing peace of mind and vitality by 2050.

https://w3.tohoku.ac.jp/moonshot/en/project_e/chihiro-hosoda/

Healthy aging from emerging sulfur life science

How do environmental factors modify aging process? Supersulfides, which are newly identified common biomolecules, play a key role in responding to oxidative stress and protecting against age-related functional decline. Sulfur life science is an emerging interdisciplinary field that creates a wide range of application outcomes, including medical science.

Exploring the Convergence Knowledge
04

[Expected Social Effects]

- Innovating diagnosis and treatment in clinical medicine, including anticancer drug development
- Helping reduce the difference between average and healthy life expectancy
- Working on environmental and food issues based on research on super-sulfides

Hozumi Motohashi

(Professor, Institute of Development, Aging and Cancer)

A fascination with the ingenious control mechanisms of gene expression led Hozumi Motohashi to work in biochemistry and molecular biology. Focusing on sulfur and aging, her research examines how the cells of organisms respond to environmental stress including oxidative stress.

When DNA makes proteins, the necessary information is transcribed into messenger RNA (ribonucleic acid). Transcription factors are special proteins that regulate transcription. Motohashi found that a transcription factor called NRF2 regulates a battery of genes whose products catalyze biochemical reactions involving sulfur. She is now interested in how supersulfides contribute to various biological processes in vivo. The supersulfides have been found to mediate multiple bioactivities such as antioxidant function, anti-inflammatory function, and regulation of mitochondrial energy metabolism. It has turned out that supersulfides are common biomolecules.

Motohashi says, "NRF2 is a very interesting transcription activator. Originally it was known as a factor that protects cells from oxidative damage by activating many cytoprotective genes. NRF2 activation is effective for delaying manifestation of age-related phenotypes. However, too much activation of NRF2 is not beneficial rather detrimental. NRF2 activity must be well controlled and should be activated only when it is needed. Cancer cells often utilize NRF2 to become malignant, acquiring therapeutic resistance and ability of aggressive tumorigenesis. How to regulate NRF2 activity is also important for cancer therapy."

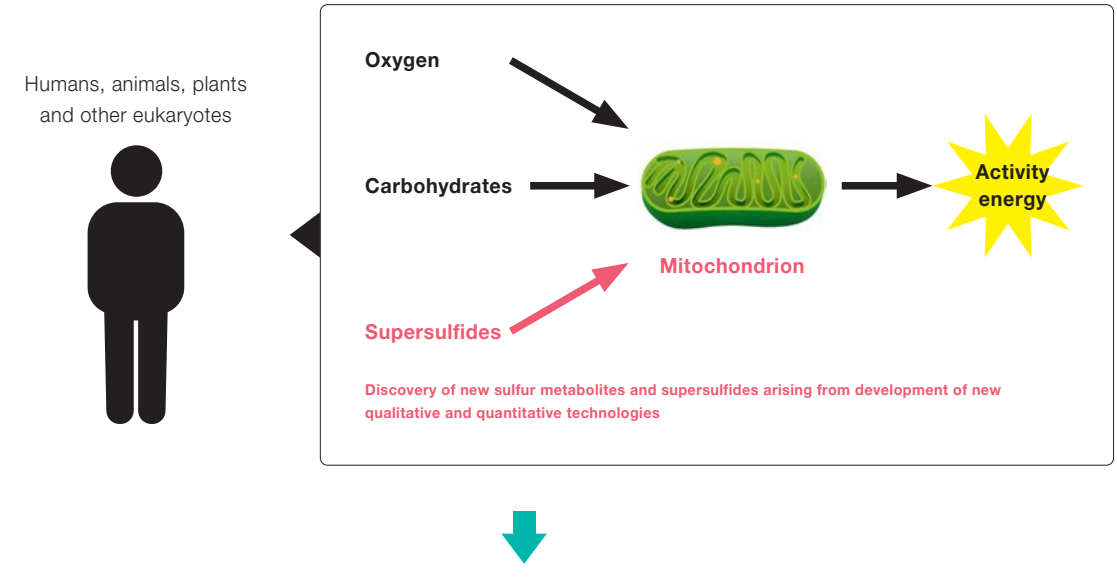
Motohashi is a leader of a large research project entitled Innovative Sulfur Biology Emerging from Super-sulfides. Running from 2021 through 2025, the project involves 34 researchers from different disciplines who are working on creating an interdisciplinary area of science. Development of new methods for quantification and visualization of supersulfides, elucidation of biological functions of supersulfides, and application of supersulfides for achievement of sustainable society are three major goals of the project.

Says Motohashi,"The study of metabolism has been aided by innovative advances in chemistry and analytical technology. This field is still largely unexplored territory—more so than genome analysis or genetic research. I feel that working with researchers from other disciplines such as physical chemistry and biology will give us a better understanding of previously overlooked supersulfides properties and lead to advances in the new discipline of sulfur life science. It will also create new approaches to environmental and food issues."

Motohashi envisions a world in which the difference between average and healthy life expectancy has been eradicated. Life in this world would be healthy and disease-free without sacrificing quality of life. But the natural aging process hardwired into all living things would still be recognized. Motohashi explains, "Of course, there are diseases that can't be treated without medicine, but that doesn't apply to aging. Food forms the building blocks of the body, and plays a key role in maintaining a healthy lifespan. As the saying goes, 'Medicine and food come from the same source,' it is believed that diet and medicine are governed by the same principles. I think there's something to that—more weight should be given to scientific studies of nutrition, and more work done together with disciplines such as biochemistry."

The Institute of Development, Aging and Cancer is working on 'breath medicine' research designed to enable early disease detection and diagnosis by identifying health conditions from measurement of the types and quantities of molecules contained in exhaled breath. Motohashi is also one of the instructors at the Tohoku University Smart Ageing College for business people. The College is helping make the world a better place by providing a broad multidisciplinary perspective that encompasses everything from health management to cancer.

Sulfur life science: A new discipline emerging from supersulfide research



- **Innovating basic life sciences, clinical medicine diagnosis and treatment**
- **Wide-reaching repercussions, such as creation of new approaches to environmental and food issues**
- **Helping reduce the difference between average and healthy life expectancy**
- **Helping create a sustainable global environment**


TOHOKU
UNIVERSITY

A Platform for Value Creation

Tohoku University continues to evolve as a platform for pioneering research and education in various fields in an environment that brings together diverse talent and combines innovative ideas with outstanding knowledge. From here, we will focus on the "talent" who drive innovation in a wide range of fields and try to find solutions to global challenges, as well as introduce the "social impact" brought about by their activities.

Aiming for Sustainable Geothermal Use and Regional Revitalization in Japan: Unleashing the World's Third Largest Potential

[Expected Social Effects]

- **Achieving reuse of hydrothermal water to ensure the sustainable use of geothermal resources**
- **Creating new values and opportunities through regional co-design**

Anna Suzuki (Associate Professor, Institute of Fluid Science)

"I would like to shape a society where geothermal resources are harnessed sustainably to fuel progress," says Anna Suzuki. Japan boasts the world's third-largest geothermal potential, yet it remains underutilized. Suzuki feels that in addition to scientific and technological challenges, there are also issues of public awareness.

We harness geothermal resources for various purposes, including power generation and hot springs. Nevertheless, it's important to recognize that underground hydrothermal resources are finite. "To ensure sustainable utilization, we must establish artificial water circulation systems allowing used water to be returned to the ground, heated by geothermal energy, and reused. The challenges lie in identifying the flow of water through complex rock fractures and predicting the effects of injected water based on the limited data measured from the ground."

Suzuki makes full use of the limited data based on mathematical and information sciences such as topology, fractional derivatives, and machine learning. For example, she has successfully extracted essential information by representing flow paths concisely as mathematical holes. This method is expected to be applied not only to subsurface flows but also to diverse transport phenomena such as in solid fuel cells.

On the other hand, she recognized that scientific development and technological innovation by themselves, cannot fully address society's problems. For example, in hot spring resorts, there has been resistance to geothermal development aimed at electricity generation.

"For the local communities, their concern revolves around the potential impact of geothermal development on the tourism industries. This led me to believe that gaining a deeper understanding of local cultures and the values of the people who held by the people residing there is essential. Consequently, I emphasize the importance of creating spaces where diverse stakeholders, including local residents, businesses, and government officials, can engage in dialogues and develop mutual understanding from their various perspectives."

This perspective stemmed from her experience during the Great East Japan Earthquake. As a student, she started to organize the Tohoku University student volunteer group "HARU," with the goal supporting the region's restoration and revitalization. During that period, she confronted challenges afflicting the region, including depopulation, an aging population, and declining industries. Additionally, her unforgettable experience in New Zealand, where she visited for an academic conference, further influenced her perspective.

"New Zealand has preserved its abundant natures and provided unobtrusive ways to enjoy sightseeing. I could sense their philosophy of respecting the values of the land. This experience convinced me that we should learn from their approach in Japan as well. At the same time, I became firmly convinced that Tohoku, with its wealth of mountains, oceans, and hot springs, holds great potential, and that we can promote Tohoku's nature."

After returning to Japan, she initiated "Waku2 as Life" in 2018 as a research outreach initiative, taking advantage of hot springs that attract individuals of all ages. The theme is "living, working, becoming healthy, and having fun in hot spring areas." The geothermal tour planned in Yuzawa City, Akita Prefecture, brought together not only geothermal engineering researchers, but also fermentation experts, cultural anthropologists familiar with the area, and others to see local resources and hold workshops for high school students. The served as a platform where participants could encounter ideas and was equally effective researcher's perspective in terms of advancing joint research.

"In this era, even computers can come up with ideas. However, what we believe, the choices we make, our thought processes, and how we shape our society all challenge the power of the human being." Regional co-design commences with trust in this inherent human capacity.

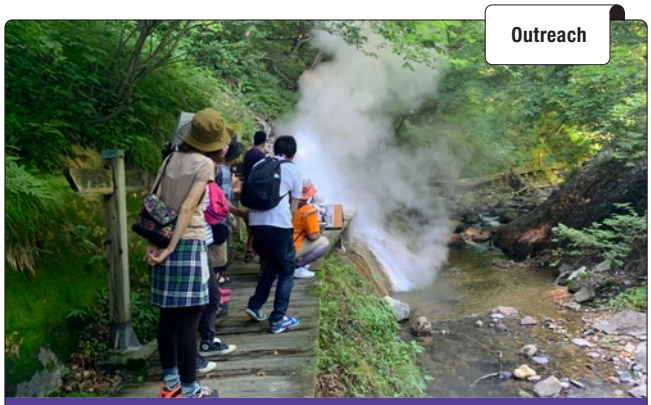
**Geothermal energy is more than just an underground resource.
By predicting the "flow" from the "shape" of the complex structure,
we aim to create a cycle that utilizes geothermal energy and the attractiveness of hot springs,
which are the pride of Tohoku. The goal is to create a place where people
from all walks of life can enjoy and become aware of the value of local resources and its utilizations.**

A place to feel, not just to reason

Waku² as Life

[Hot Springs] + [OO] = local production and local consumption of local resources & improvement of overall happiness in Japan

The excitement of curiosity about the unknown creates new connections and crosses frames composed of values and awareness of issues



[Hot Spring] + [Intellectual Curiosity]

[Hot spring] + [Community Building]

[Hot spring] + [Science]

[Hot spring] + [Work] + [Health] + [Childrearing]

From Environmental DNA Data to a Nature-Positive Future

[Expected Social Effects]

- **Returning value of biological ecosystems to local communities**
- **Creation of a society that coexists with nature through environmental DNA technology**
- **Contribution to the creation of rules that balance biodiversity and business**

"Nature positive," the concept of halting biodiversity loss and restoring it, is the next wave of social transformation after carbon neutrality. The Task Force on Nature-related Financial Disclosures (TNFD) asks for the disclosure of information on the impact of corporate activities on and dependence on nature as well as the risks and opportunities from that, and it seeks to use this information to forge a biodiversity-conscious flow of funds.

In May 2022, Tohoku University became the first Japanese university to participate in the TNFD Forum, endorsing the TNFD philosophy and supporting its activities. Michio Kondoh of the Graduate School of Life Sciences and Kaori Fujita of the Green Goals Initiative are developing proposals based on "Environmental DNA Technology," a new biological survey method that collects water from rivers and oceans to examine all kinds of DNA. Kondoh, who specializes in ecology, says, "What we are aiming for is the overall optimization of both business and biodiversity. Primary information on the organisms living there is the basis for everything. With our environmental DNA technology, we can not only provide primary information but also clarify the impact of humans on the environment by comparing values from different locations."

How much risk does a company's economic activity pose to nature, and what efforts are being made to reduce it? In the past, nature conservation activities were conducted as a part of social contribution activities for companies, but nature-positive management, in which the impact on nature and risks are assessed and activities are promoted, is directly related to the company's core business. Fujita tells of her experience as a journalist following biodiversity and business issues. "My role is to contribute help create a platform where companies, investors, and academia can share information. I hope to contribute to the creation of communities that coexist with nature, based on resources such as the data provided by Kondoh, from the perspective of both my experience of walking through the communities and experiencing the nature and cultural climate and my knowledge of the various rules governing industry.

However, everyone has a different perspective on nature. Above all, even a single river involves a wide variety of people. "In Toyama Prefecture where I come from, the Kurobe Dam and other dams were built as part of a national policy to advance hydroelectric power after World War II, and the landscape and ecosystem have been completely transformed. On the other hand, the Kurobe-Tateyama Alpine Route, which runs through the Northern Japanese Alps, was built and attracts one million tourists a year. Companies take industrial water from rivers and local fishermen also benefit from rivers, but I hear that some fishermen are harmed by the discharge of sediment from dams. It is time to consider the best conditions for all people in reducing risks to nature and receiving benefits while building relationships with each other," says Fujita.

The Task Force on Nature-related Financial Disclosures (TNFD) is an organization that works to bring financial flows to biodiversity. Tohoku University is the first university in Japan to participate in the TNFD Forum, a support organization for the TNFD.

Based on "Environmental DNA Technology," a revolutionary biological survey method, Tohoku University will contribute to the creation of a social structure that values living organisms and ecosystems.

Tohoku University is collaborating with other institutions to build ANEMONE, a network system for observing environmental DNA. Surveys are easy to do by simply collecting water' and if local elementary and junior high

Michio Kondoh (Professor, Graduate School of Life Sciences)
Kaori Fujita (Professor, Green Goals Initiative)

**The Task Force on Nature-related Financial Disclosures (TNFD) is an organization that works to bring financial flows to biodiversity.
Tohoku University is the first university in Japan to participate in the TNFD Forum, a support organization for the TNFD.
Based on "Environmental DNA Technology," a revolutionary biological survey method, Tohoku University will contribute to the creation of a social structure that values living organisms and ecosystems.**

school students participate in the surveys, they will have the opportunity to become aware of the value of the resources in front of them. According to Kondoh, "Now is a good time for three things to be happening at the same time. Data acquisition methods are expanding, data processing technology is advancing, and there is a trend towards nature positivity. Our role is to create a social framework that maximizes the value of living organisms and ecosystems through the best mix of those."

It is always small changes in local communities that bring about change in the world. "The first step is to make people in the community happy." That is the major goal that the two of them have set.

Survey
1,000 sites

Observation
5,000 times

Detection of
900 fish species

as of July 2023

ANEMONE

- Established in 2019 at Tohoku University's initiative in collaboration with universities and national laboratories across Japan
- Routine monitoring of environmental DNA at 77 sites (55 coastal areas, 18 rivers, and 4 lakes)
- A wide range of players from industry, academia, government, and citizens participate in observations

Create a “world where people learn as they play” together with Tohoku University

[Expected Social Effects]

- **Making “learning fun” into a social infrastructure through quizzes**
- **Raising the level of education by bringing out intellectual needs**
- **Improving communities through innovations in the education system**

baton is working to create services that enrich the world by merging “play” and “learn.” Putting web-based media QuizKnock, launched in 2016, as the core of its business, and with “Quiz King” from the University of Tokyo Takushi Izawa, the company has built a business model centered on quizzes, utilizing TV as a medium as well. The company is also developing a variety of other businesses, such as a YouTube channel and creating game applications that train intellectual abilities.

Yosuke Kinugawa says, “Our starting point is questioning of Japanese education system. I wanted to address a market where experience-oriented education is considered important but has not been resolved for a long time. On the other hand, I felt a sense of crisis in Shanghai, China, where I was posted from a previous job, because university entrance examinations were extremely intense and internship systems had been established for university students to gain practical experience at companies. The only way for Japan to compete with the rest of the world is to create new value in education itself. I wanted to build a system of ‘learning’ that would allow students to deepen their knowledge while having fun at the same time, rather than burn themselves out after passing a university entrance exam.”

The catchphrase is “make learning fun.” Our goal is “a world where people learn as they play.” While holding a vision of a society where everyone in the world can continue to learn with curiosity, he says, “First of all, I want to create a theme park of knowledge.” He envisions a “Disneyland of knowledge” or a “museum with entertainment” where people can enjoy participating in intellectual attractions and will want to come back again and again. One of the steps toward this goal is the conclusion of a comprehensive collaboration agreement with Tohoku University’s “Co-Creation Education Project” Green Goals Initiative, which was done in December 2022.

“Tohoku University is the first university in Japan declare an ‘Open Doors’ principle, and has always emphasized its connection with society. It is also filled with a frontier spirit to deepen academic studies, which was prompted by the Great East Japan Earthquake. Above all, the university’s commitment to making people aware of the fun of learning, technological innovation, and new services is in line with a philosophy of creating a system for learning while having fun. We hope to combine the university’s vast knowledge with our expertise in communicating difficult topics in an easy-to-understand manner so as to deliver even more enjoyable learning in an innovative way.”

In March 2023, baton and Tohoku University held the “Science spring social studies tour to learn about the earth” in collaboration with Minamisoma City, Fukushima Prefecture. Junior and senior high school students from Minamisoma and Sendai cities had the opportunity to experience quizzes and deepen exchanges with QuizKnock members. The program centered on the Science Café “Making, Storing, and Using

Science spring social studies tour to learn about the earth
@Minamisoma City, Fukushima Prefecture (March 18, 2023)

baton Co., Inc., organizer of QuizKnock, has signed a collaboration agreement with Tohoku University on "Building the Future through Education." By integrating each other's accumulated knowledge, ability to communicate, planning ability, and community relations, they will create new social value of learning like playing and playing while learning.

Yosuke Kinugawa (CEO, baton inc.)

Hydrogen" by Hitoshi Takamura(Professor, Graduate School of Engineering).

"QuizKnock members provided explanations and support for talks, serving as a glue, so to speak, to make it understandable even for junior high school students. Spending time with university students, researchers, and people you see on TV is a rare encounter in itself. We are thinking of adding quiz and game elements to school excursions to make them more entertaining, and I feel that this event was an experiment in that direction."

Plans are to expand the current one-day event into a week-long camp format, establish a credits-earning program, and otherwise make diverse developments. It is the future society itself that will benefit from this kind of learning by the younger generation.

TOPICS

baton and Tohoku University signed a collaboration agreement on "Building the Future through Education"

baton and Tohoku University signed a collaboration agreement on December 14, 2022, with the aim of restoring Fukushima and building the future. Based on this agreement, they will cooperate in comprehensive educational innovation planning and its implementation utilizing the QuizKnock brand and the like, as well as the introduction of experimental educational programs. By integrating Tohoku University's and baton's knowledge, experience, media communication ability, and planning and development abilities, the parties aim to create new social value that will contribute to regional development.

From the Front Lines of Generative AI Research and Natural Language Processing Research

[Expected Social Effects]

- **Improvement in efficiency and cost reduction through automation of routine tasks**
- **Facilitation of creative production such as images and videos**
- **Creating an environment in which people can concentrate on tasks that only they can perform**

ChatGPT, released by IT venture Open AI in November 2022, is one of the large-scale language models that applies generative AI (artificial intelligence). This interactive application, which answers questions with natural expressions, has quickly spread around the world, thanks to its user-friendly interface that supports any language. It has also been introduced at Tohoku University for system operation and public relations. Keisuke Sakaguchi of the Graduate School of Information Sciences, who researches Natural Language Processing (NLP) using computers, explains it in this way.

"While previous AI applications have mainly performed tasks that classify sentences and images, generative AI generates natural sentences and images based on context. In the case of ChatGPT, the AI learns various patterns in natural language and constructs sentences based on the vast amount of text data it receives. My own recent research has focused on developing technologies that enable AI to access real-time information and context and interact smoothly with humans."

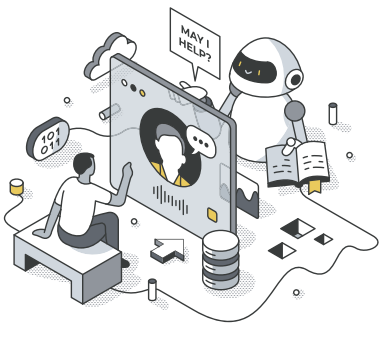
Although the implementation of ChatGPT in education and research is still in the trial-and-error stage, researchers and students around Sakaguchi are already using it on a daily basis to streamline their work in areas such as writing English e-mails and abstracts for academic papers. In the future, it is expected that the system will be implemented for proofreading of papers, programming education, support for the creation of teaching materials, and the like.

On the other hand, the issue for ChatGPT is that it is not up to date with the latest information and may fluently speak incorrect content. In addition, criticisms and confusion have arisen, such as the impact of the spread of fake news on people's opinions and behavior, automated report generation by students, and art works created by image-generating AI infringing on the copyrights of real third parties. So, Sakaguchi's research also covers the evaluation and ethics of such large-scale language models.

"The spread of ChatGPT and the improvement

Keisuke Sakaguchi (Associate Professor, Graduate School of Information Sciences)

What is natural language processing?



NATURAL LANGUAGE PROCESSING

Natural Language Processing (NLP) is a technology that allows computers to understand the language that people use daily. When we input text or words to a computer, it can analyze them, understand the meaning and grammar, extract information, and generate responses.
ChatGPT is a natural language processing model, and in May 2023, Tohoku University became one of the first university in Japan to introduce it in its administrative operations. The university is also developing an internal operation and support system, including guidelines for students and faculty, regarding the use of ChatGPT and other generative AI. We will further promote the use of AI with a view to applying it to education and research.

ChatGPT is a generative AI application created in the U.S., which has spread around the world at an unprecedented speed. What is the current state of large-scale language models that enable humans and artificial intelligence to interact very naturally, and what is the goal aimed for? Take a look at the research at Tohoku University, which proceeds with consideration of its societal impact.

in deep learning performance have both been much faster than predicted. Researchers must be more aware than ever of social impacts including risks. I personally see the potential for NLP applications such as ChatGPT to be useful in more familiar and diverse situations. Even in worksites where overtime work is being done due to lack of, if ChatGPT and other applications can reduce the workload, that may allow people to focus on important and emergent tasks."

In addition to the development of multimodal models that simultaneously process multiple types of information such as text, images, and audio, the laboratory is also involved in industry collaboration research and development of large-scale Japanese language models in collaboration with CyberAgent, Inc. and other companies. Japanese language has ambiguous word order and speech patterns and greater variety of characters used, making the hurdles higher than with other languages; but it thought that implementation to society as an application will be seen in the next one to two years.

Sakaguchi's major during his undergraduate studies was philosophy of language. He studied psycholinguistics and neurolinguistics at the University of Essex (UK) out of an interest in where people's ability to manipulate language comes from, and then he studied natural language processing at the Nara Institute of Science and Technology and Johns Hopkins University (US). "I want to unravel the complex mechanisms of human language processing. This is both my starting point and a dream I am pursuing." NLP research is a means to that end, and ChatGPT is just a step. An endless passion for "human beings" and "language" will bring about changes in our social life.

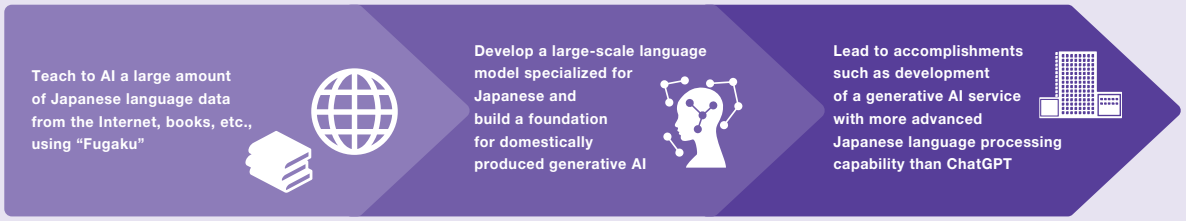
TOPICS

Technological development of a large-scale language model specialized in the Japanese language using the supercomputer "Fugaku"

powered by FUGAKU

Tohoku University, together with Tokyo Institute of Technology, Fujitsu Limited, RIKEN, CyberAgent, Inc. and others, has started development on technology that will serve as a template for generative AI with high Japanese language processing capability, utilizing the large-scale parallel environment* of "Fugaku." The development of domestically produced AI is expected to lead to innovative research and creation of businesses never seen before.

*Large-scale parallel environment: A system in which a large number of processors and computers are connected to perform very complex calculations using large amounts of data in a fast and efficient manner.



Strategic Digital Transformation as a University Leading Social Change

[Expected Social Effects]

- **Active incorporation of the latest technologies and dissemination of work methods appropriate to changes in society both inside and outside the university**
- **Contribution to the fostering of a digital transformation mindset and skills beyond the boundaries of the university**
- **Improvement in engagement through the "Tohoku University App," which connects with all stakeholders**

In June 2020, Tohoku University announced its "Declaration of Online Administrative Services." The university has been working to improve operational efficiency through digital transformation, based on the pillars of "counter-free," "hanko (seal)-free," and "worksite-free." This is a realization of the Tohoku University Connected University Strategy, which calls for "advancement of university management through data utilization" and "transformation to a way of working appropriate for the new normal era." Kazuyuki Fujimoto, director of the Digital Transformation Division of the Information Department, oversees the Administrative Digital Transformation Promotion Project Team.

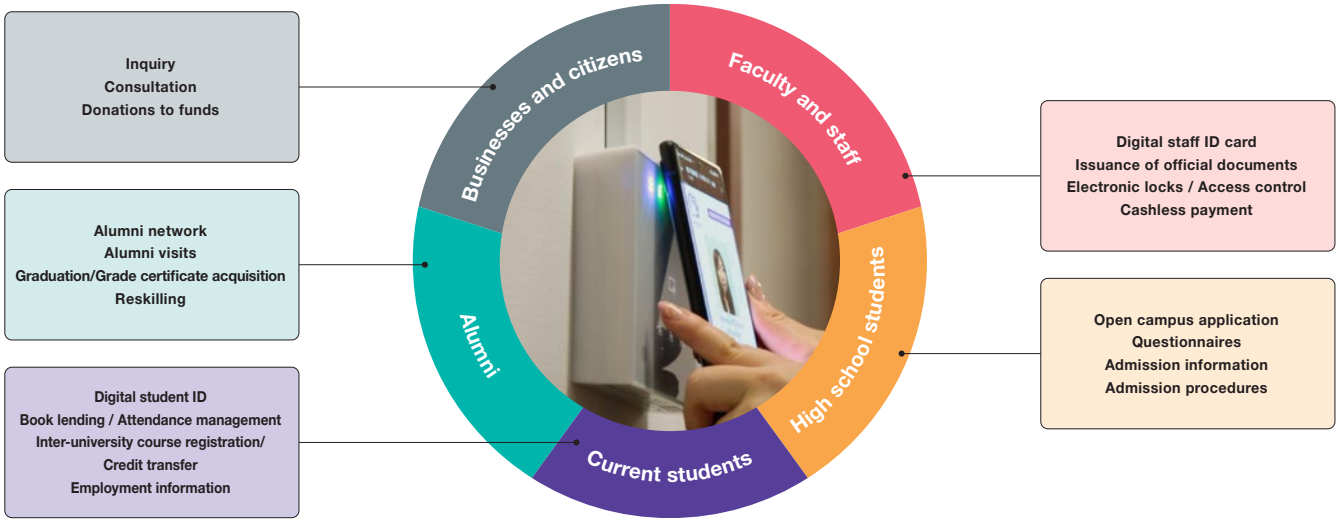
"Needless to say, the trigger that accelerated digital transformation was the COVID-19 pandemic. However, learning from the experience of the Great East Japan Earthquake in 2011, when all operations were suspended, the university had prepared a remote work environment, including the introduction of a cloud infrastructure. Thus, all faculty and staff were able to smoothly transition to telecommuting in April 2020 when infections spread rapidly. Digital transformation is not limited to administrative work; it is also the foundation that supports an environment in which students and faculty can focus more on studies, education, and research."

The structure is progressive and strategic. A Chief Digital Officer (CDO) was created and Executive Vice President Takafumi Aoki was appointed to that position. More than 50 project members, whose average age is approximately 36 years old, were recruited internally from across the university's organizational boundaries. Both the establishment of a CDO and the formation of the team through open recruitment were firsts by a national university. The team members have carried out their mission with a strong will to take one step further, to think about what kind of environment they would like to work in and what is necessary to achieve it, and they have achieved remarkable results in a short span of time. The ChatGPT, a type of interactive artificial intelligence (AI) system, has already been introduced in the areas of system operation and public relations. Work is underway to gradually apply it to the fields of education and research as well. These efforts are attracting attention from outside the university as well, and an endless number of requests for tours are being received.

"We believe that digital transformation can do more than just increase the value of the university. By spreading our know-how and skills to other universities, we can improve the quality of education and research in Japan, and ultimately contribute to the new normal society." In addition, a "Tohoku Region Administration Digital Transformation Team" has been established to advance based on digital transformation together with national universities and other institutions in the Tohoku region while exchanging personnel. "Digital transformation is only possible through a

Tohoku University App connecting with society

A variety of services unique to a university are provided to a wide range of people, from pre-entry to post-graduation, and to the public at large. The aim of the "Tohoku University App" to serve as a bridge between the university and society.



The project team was formed through open recruitment within the university, a first for a national university. The team anticipated the work styles of a new normal era and achieved streamlining of administrative work through Digital Transformation and expanded the possibilities of education and research. Such skills and know-how are attracting a great deal of attention from other universities as well.

change in the mindset of each and every one of us. The challenge is to foster the mindset. We are striving to create an environment that encourages motivated young people and enables them to demonstrate their capabilities beyond the barriers of conventional work methods and organizations."

The current focus is the development of the "Tohoku University App." The target is all stakeholders, from high school students considering taking entrance exams to current students, alumni, faculty and staff, as well as joint research partners and companies and donors. It is a platform for "enrollment management" that provides various services through interactive communication and has an aim of enhancing university management, including human resource development, by using marketing methods to accumulate and analyze data. It is, so to speak, a gateway to connect with the world, taking the form of a "university engaged with society." By 2025, all students and faculty/staff are expected to have the app.

Beyond our sight, a vision of lifting up Japan's social economy expands. "At the core of our vision is the desire to be university where future generations want to study and a Japan that is ready to compete with the rest of the world. Digital transformation is one way to achieve this. In the end, it is the 'people' who use digital technology and what lies beyond."

Kazuyuki Fujimoto (Director, Digital Transformation Division, Information Department)

Tohoku University Digital Transformation Navigation
https://www.dx.tohoku.ac.jp/english_home/

TOPICS

Special award received at "Japan Digital Transformation Awards 2023"

The University's "Administrative Digital Transformation Promotion Project Team" was selected as a finalist in the People and Organization (Reskilling) Category at Japan Digital Transformation Awards 2023, a contest sponsored by the Japan Digital Transformation Awards Executive Committee. At the final competition held in June 2023, the team gave a lecture titled "From Passive to Active - The Challenge of the Administrative Digital Transformation Promotion Project Team." The team was awarded a "Special Award" for its strong advancement of digital transformation through its human resources and organizational abilities.

Sharing BOSAI(disaster risk reduction) with the world through the “World BOSAI Forum”

[Expected Social Effects]

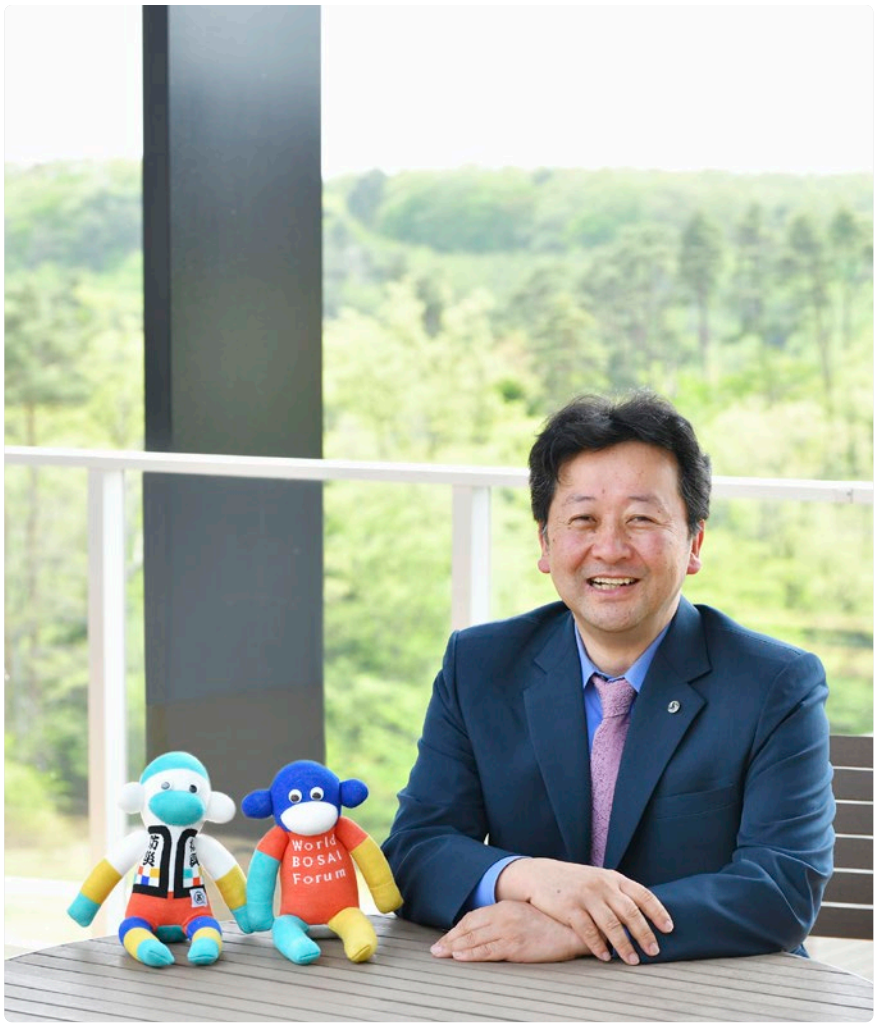
- **Create new value for BOSAI (disaster risk reduction or DRR) by bringing together stakeholders from industry, government, and academia**
- **Advance the “Sendai Framework for Disaster Risk Reduction 2015-2030” by sharing knowledge on disasters and DRR with the world**
- **Resolve regional issues and forge a sustainable society by enhancing resilience against disasters**

The International Research Institute of Disaster Science(IRIDeS), Tohoku University, was launched one year after the 2011 Great East Japan Earthquake and Tsunami. In IRIDeS, researchers in engineering, science, humanities and social sciences, medicine, and DRR work across disciplines together to advance disaster science and practice DRR. Deputy Director of IRIDeS, Yuichi Ono, specializes in climatology. He was involved in DRR policy-making as a UN official at the World Meteorological Organization (WMO) and the UN International Strategy for Disaster Reduction Secretariat (now the United Nations Office for Disaster Risk Reduction). After joining Tohoku University, he supported the invitation of the Third UN World Conference on Disaster Risk Reduction (2015) to Sendai and contributed to adopting the Sendai Framework for Disaster Risk Reduction(SFDRR) 2015-2030, a global guideline for DRR.

“As the host country of the UN Conference, Japan has a mission to promote the SFDRR in cooperation with the international community. After the conference, we would like to have a ‘legacy’ of the conference here in Sendai to communicate BOSAI/DRR messages from Tohoku to the world. The World BOSAI Forum was established with that in mind. In UN conferences, opinions at national government levels are exchanged. Academic conferences are for experts. But the World BOSAI Forum is different. The Forum is for diverse stakeholders from industry, government, and academia, and also from citizens. It is a scheme to promote BOSAI as a universal word and encourage people towards DRR, to create new value through free and dynamic discussion of DRR issues, and to promote implementation of the SFDRR, sharing lessons from the 2011 disaster with the world.

2023 is a “turnaround point” for the SFDRR. In March 2023, the World BOSAI Forum 2023 was held in Sendai with over 5,400 participants from 40 countries and regions. At the Forum, participants held discussions about the SFDRR Interim Evaluation Meeting to be held in May 2023. At the closing ceremony, we handed over the Forum’s recommendations to the Head of UNDRR, Ms. Mami Mizutori.

Another “engine” for advancing the implementation of the SFDRR is the “Global Centre for Disaster Statistics,” established by the IRIDeS, Tohoku University, in collaboration with the United Nations Development Programme (UNDP). Ono was



Yuichi Ono (Deputy Director of IRIDeS/Representative Director of the World BOSAI Forum)

Excursion in Minamisanriku Town

The World BOSAI Forum, established after the Great East Japan Earthquake and Tsunami, is a forum for creating new value related to disaster risk reduction that goes beyond the boundaries of industry, government, and academia. In cooperation with related organizations in Japan and abroad, it is working to create knowledge in disaster science and convey BOSAI from Sendai to the world.

also involved in the creation of the Centre. DRR policies need to be based on past disaster damage statistics. However, many countries around the world have inadequate vital statistics. Therefore, the Global Centre has started to support the comprehensive and systematic collection of disaster damage statistical data that national governments manage. The collected data will be useful for formulating DRR policies in individual countries. The Global Centre for Disaster Statistics monitors the progress toward the global goals of the SFDRR and paves the way for achieving them. In collaboration with the World BOSAI Forum, it will contribute towards the reduction of disaster loss and damage.

Ono and his colleagues are working on the inclusion of BOSAI within the Post Sustainable Development Goals (SDGs) as a stand-alone goal when the SFDRR and SDGs expire in 2030. “If this is achieved, BOSAI will rapidly spread globally, accelerating investment in DRR, which is essential for disaster reduction and Building Back Better. It will advance measures against climate change as well.” Improving disaster resilience will lead to the sustainable development of local communities and economies. Tohoku University is deeply involved in t developing various rules for disaster risk reduction. It is working to solve issues of the international community by heightening the social value of BOSAI to save human lives and support a sustainable society.

World BOSAI Forum2023 in SENDAI

What is the Sendai Framework for Disaster Risk Reduction 2015-2030?

The Sendai Framework for Disaster Risk Reduction 2015-2030 is a framework for disaster risk reduction developed by the United Nations. It was adopted at the Third UN World Conference on Disaster Risk Reduction held in Sendai City in 2015. The aim of the framework is to reduce disaster risk over a 15-year period until 2030. It defines specific goals and cooperative arrangements and serves as an important guideline for national and regional policymaking and implementation.

Becoming a Value Creation Platform Open to the World Through the Pursuit of Internationality

[Expected Social Effects]

- **Fostering talent that will lead the global era**
- **Attraction of diverse talent from around the world to help solve social issues**
- **Contribution to the advancement of Japan and the world through co-creation with diverse stakeholders**

Global Gateway 01

Revolutionizing information and communications technology by superconducting spintronics research

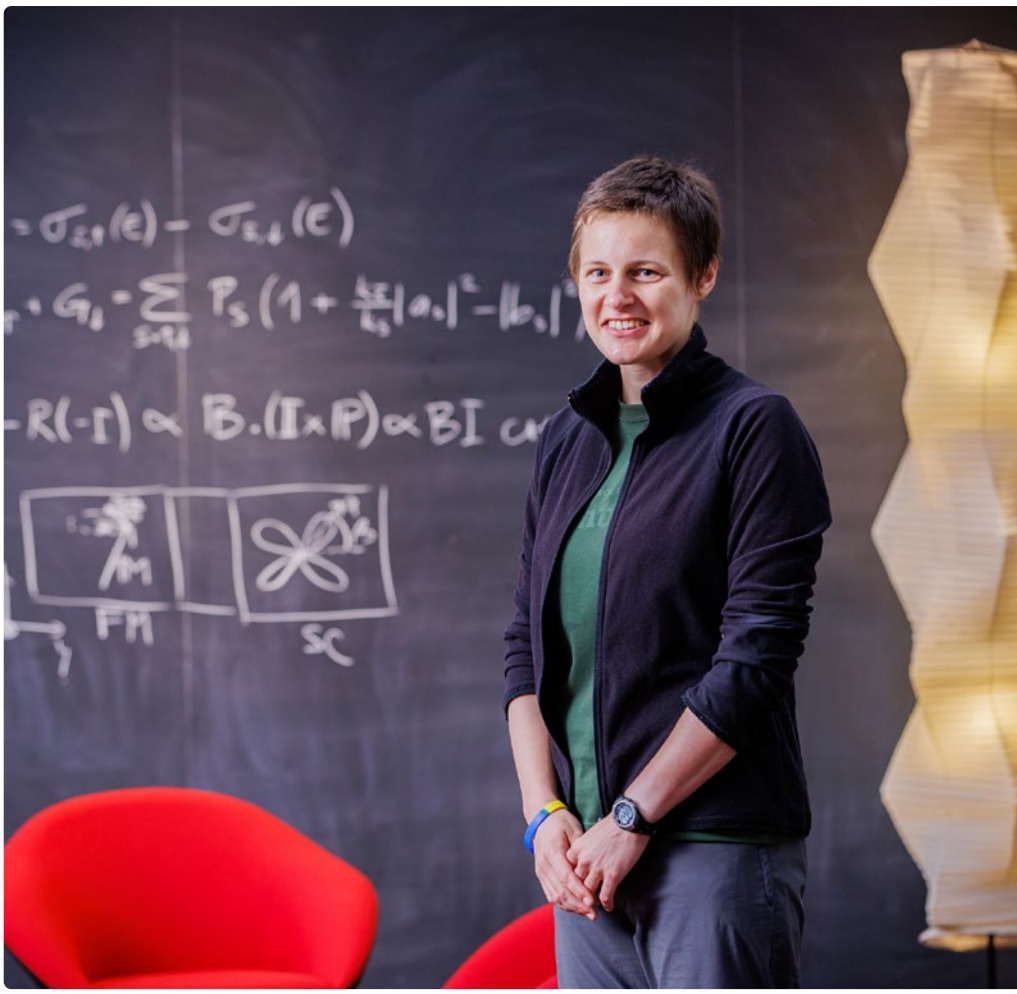
Tohoku University is leading the world in spintronics research. Lustikova graduated from the Faculty of Science and the Graduate School of Science and aims to develop new electronic devices using spin at the Center for Science and Innovation in Spintronics in competition with top-level researchers.

Spintronics research aims for the engineering application of the charge and spin properties of electrons. In that, "superconducting spintronics," which explores new physical properties by controlling spin through the interaction of superconductors and magnetic materials, is a field gaining particular attention. Jana Lustikova of Tohoku University's Center for Science and Innovation in Spintronics (CSIS), a world-class research center, is studying methods to control the spin flow in superconducting thin films in search of principles that will lead to new electronic devices.

Lustikova came to Japan from Slovakia in 2009 as a government-sponsored exchange student. After studying Japanese language at Tokyo University of Foreign Studies for one year, she entered the Faculty of Science at Tohoku University.

"When I was in high school, I was interested in spintronics, which is concerned with what happens when you pass electricity through a magnet. I was also interested in Japanese culture, so I wanted to study in Japan and at Tohoku University, which is a leader in this field of research. In graduate school, I was given a high-level topic in the laboratory of Eiji Saitoh, a world authority in the field, and it was a big step for me to take on the challenge of that difficult problem."

Lustikova, who was granted the title of "Tohoku University Prominent Research Fellow" in 2022 for young researchers who



Jana Lustikova (Assistant Professor, Center for Science and Innovation in Spintronics)

What strategies should be used to design a new ecosystem for a research university? As one such strategy, Tohoku University will create a platform for a dynamic ecosystem for value creation by pursuing thorough openness and internationality where diverse and varied talent is welcomed.

take on the challenge of original research that opens up new frontiers, says with a twinkle in her eye that the motivation for her research is "the beauty of physics concepts."

"In superconductors, electrons with opposite spin usually pair up and cannot carry the magnetic information of electron spin; but recent studies have suggested a mechanism by which electron spin can propagate over long distances even in superconductors. Spin control is faster and more efficient than the charge control utilized in ordinary electronics. Since electricity flowing through a superconductor does not generate heat, it is suitable for applications such as new high-speed, low-power-consumption information communication methods and environmentally friendly energy conversion technology. If the speed of information processing is dramatically increased, the processing capacity of data centers will improve, and the development of cloud computing and the practical application of various wearable devices will also advance dramatically. We hope that our fundamental research will be useful to researchers working on related topics and contribute to society by creating a positive chain in research."

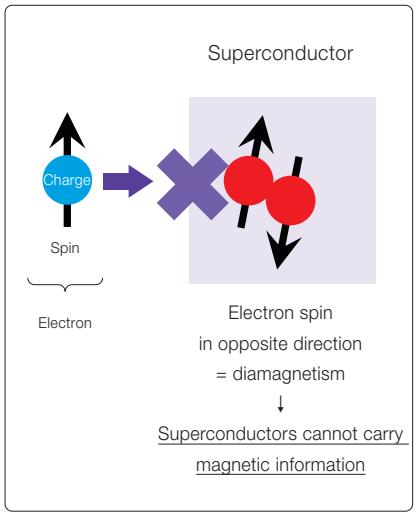
Five out of six members of Lustikova's laboratory are from countries other than Japan. Needless to say, Tohoku University has a large number of international students, researchers, and faculty members from other countries.

"Tohoku University helped me get used to life in Sendai even when I was a student. Tohoku University is attractive thanks to its many research fields and laboratories. There is a good atmosphere where you can consult and interact with other researchers, and there are also a lot of facilities that can be used jointly, creating an environment where you can devote yourself to research."

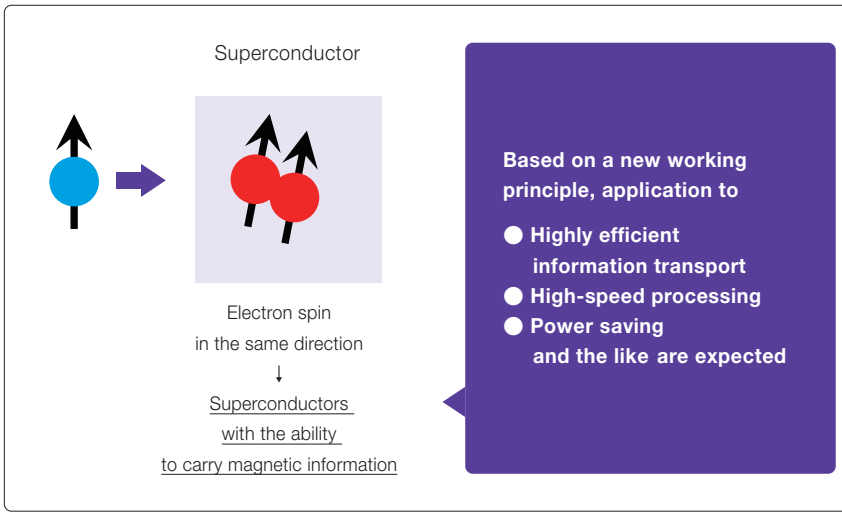
It was an encounter with a teacher in high school that inspired her to pursue physics in the first place. She led her into the world of physics by discussing questions about everyday things, such as "Why are sunsets red?" Tohoku University also holds the "Katahira Festival" once every two years to deepen elementary, junior high, and high school students' interest in science. Each research institute presents its research and provides opportunities for them to experience science through experiments. "Physics is a field that deepens our scientific understanding of everyday phenomena. I hope that our fundamental research will become widely known and more people will become interested in it."

What is superconducting spintronics?

The "conventional wisdom" of superconductivity



Superconducting spintronics



*Superconductivity is a phenomenon where electrical resistance becomes zero. When electricity flows through a superconductor, heat is not generated, and electricity thus can be transmitted without loss of electrical energy.

Global Gateway 02

Strategic Housing Reconstruction and Land Use to Rebuild the Hearts and Lives of Disaster Victims

A land use system that emphasizes the node link between urban and rural areas is applicable to areas where the environment has been drastically altered by disasters and warfare. Furthermore, it paves the way for a resettlement and reconstruction approach that emphasizes individual relief and growth, such as fostering motivation to truly rebuild lives through the process of rebuilding homes for disaster victims.

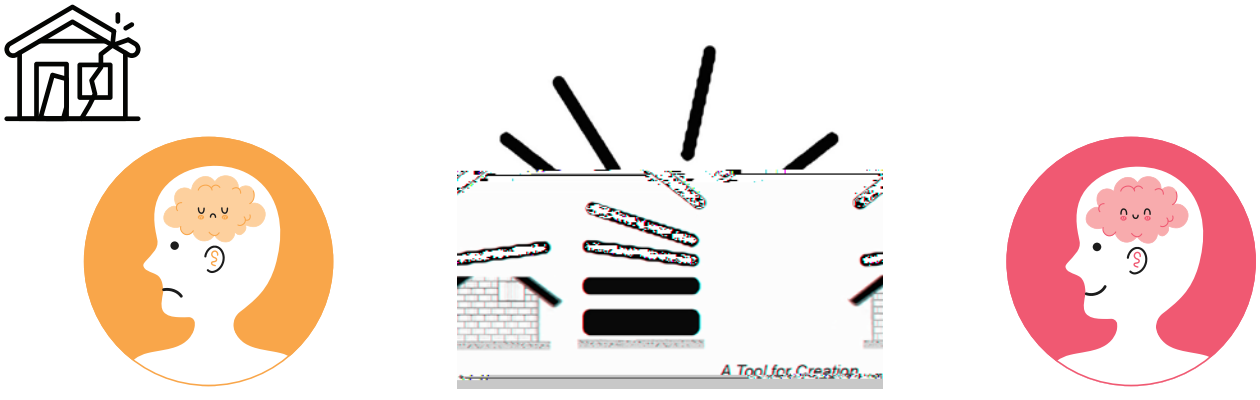
Martin, born in Peru, came to Tohoku University in April 2018. His current research focuses on building strategic schemes for evacuation and displacement due to natural disasters and war from an urban planning perspective. The key point is to focus on psychological relief for victims and to encourage resettlement by taking into account jobs and the surrounding environment. The starting point for the research is the problem of poverty in rural areas of his home country of Peru and the people who suffer from droughts and floods. One of the projects currently working on is the "Land Use and Transport Microsimulation Model(OLUTM)" a study of land use in peri-urban areas.

"OLUTM, for example, envisions a center with urban functions, agricultural lands, commercial and industrial areas, and forests that are connected and economically developed to the outer edges. Urban residents can enjoy nature, and rural residents can access urban education, healthcare, and financial services. Protecting the boundary also helps to prevent unplanned urban expansion while preserving agricultural areas. These agrarian urban boundary concepts can be applied to areas that have undergone drastic changes due to climate change or warfare. We are in the process of developing user-friendly software through simulations."

Another project is the "One United Recovery Organization (OUR)," a non-profit organization for people who have lost their homes in disasters. The goal is to standardize a system for rebuilding homes and lives at low cost. OUR has developed a "Standardized Self-Construction Toolkit" that allows anyone to easily assemble a safe, comfortable, and private space. "Building a home with one's own hands is a motivation to rebuild one's life and a chance to regain one's mental health. The product is an easy-to-use tool with customized materials and a construction guide that makes it easy for even those with no construction knowledge, to transition from a temporary housing to a permanent structure. Beyond helping people through adversity in terms of housing, the project has value from a welfare perspective, providing self-help tools for learning and achieving a milestone after catastrophe, thus helping people to restore livelihoods after disaster events."

The toolkit was funded in 2021 through the Tohoku University Student Challenge Crowdfunding "TomoPro" to refine it in preparation for its operational launch. In fact, Martin's interest in disaster-related issues began when he participated in the "Multi-Hazard Program" organized by the International Research Institute of Disaster Science at Tohoku University as the hub of the Association of Pacific Rim Universities (APRU), an international

Reconstruction with a standardized self-construction toolkit



Damage to your home due to disasters, etc.

Anyone can easily rebuild a home with a kit

Increase motivation by rebuilding your own life

Image of the Self-Construction Toolkit being used for permanent housing

Garcia-Fry, Martin **(3rd-year doctoral student, Graduate School of Engineering, Tohoku University)**

university consortium of which Tohoku University is a member. He also discoverd the potential of OUR as a business through Tohoku University's entrepreneurship educational program through the Exploration and Development of Global Entrepreneurship for NEXT generation (EDGE-NEXT) project.

"Tohoku University has a great research environment and the City of Sendai is very attractive. Although it is a medium-sized city, large forests surround the city inspiring scientific pursuit. The city also experienced a large-scale earthquake and tsunami, so it renders an ideal setting for OLUTM model simulations."

His dream is to establish the OUR initiative as a non-profit organization and automate the OLUTM model to derive proprietary software for sustainable urban development in the United States, Japan, and Peru. Thus, seeds born at Tohoku University will spread throughout the world.

Global education and research environment

Excellent help provided by the International Support Center

When international researchers and students start their lives in Japan, they are often burdened with a variety of procedures due to differences in systems and customs as well as language barriers.

The International Support Center, established in April 2022, provides integrated and comprehensive support for international researchers and students from their arrival in Japan to departure. This includes administrative procedures, opening bank accounts, and finding rental housing, enabling them to focus on their research and educational activities at Tohoku University with peace of mind.

International Support Center ▶ https://sup.bureau.tohoku.ac.jp/en/

Pre-Arrival

After Arrival

University Life

Leaving Tohoku University

COE/Residence Status

Life in Sendai

Global Gateway 03

Overseas Experience Leads to NPO Research Based on Design Thinking

Haruka Minemura makes full use of Tohoku University's overseas training system and educational programs. In addition to acquiring problem-solving skills through the Bedside Solution Program, Minemura also studies NPO management from an international perspective, including hands-on experience at a medical NPO in Cambodia.

Haruka Minemura, who studies nonprofit organizations (NPOs), has had her sights on the international stage and been proactive since immediately after entering Tohoku University. She has studied abroad for short terms in the U.S., Vietnam, and other countries through the university system, and she has also worked as a tutor for international students and as an assistant for international co-education classes. In 2022, she also took on the challenge of an internship at an NPO.

"The catalyst to jump in this research field was in high school. My best friend to suffer mentally due to her personal issues, but I was not able to do anything at all. I realized how powerless I was to protect the people I cared about, and this drive me to learn more about the wider world to help solve social problems."

It was with this in mind that she launched Project San-Eleven, a student organization to share the story of experiences in the Great East Japan Earthquake. While working with various organizations, she became interested in non-profit economic model of NPOs, especially their organizational management. In her senior year of university, she participated in the University Innovation Fellows program (UIF) offered by Hasso Plattner Institute of Design at Stanford University, where she acquired problem-solving skills through design thinking that uncovers issues and needs and promote university reforms.

Along with this, she participated in the "Bedside Solution Program" at Tohoku University Hospital, where companies explore the needs of medical sites and aim to develop new businesses. She joined the project to solve issues of reducing overtime hours at medical sites.

However, although she believed in the potential of NPOs, there was a time when she almost lost confidence in them due to factors such as the outbreak of COVID-19. "It was then that I met Dr. Hideto Yoshioka, a pediatric surgeon and chief advisor to the certified NPO Japan Heart, through the Bedside Solution Program. When I told him about my research on NPOs, he said, 'You orient the future.' Encouraged by this comment, I jumped into the medical assistance in Cambodia that Japan Heart was running."

Based on her experience at UIF and Tohoku University Hospital, she has been able to improve operations at the hospital from an outside perspective and accompany medical staff on rounds to underpopulated areas to provide medical care. By standing in the field, she was able to see firsthand the excellent and underdeveloped aspects of NPOs, which strengthened her desire to become a

Haruka Minemura (2nd-year master's student, Tohoku University Graduate School of Economics and Management)

researcher who can contribute to their activities.

"I was impressed to see the ways of life of the people in the diverse professions at Japan Heart. I wanted to support their ambition and disseminate their activities to the word broadly. At the same time, my perspective of working overseas itself changed. I met people from various backgrounds and ways of thought, and I feel that the understanding of myself has deepened."

While abroad, she continued to take "Global Program in Economics and Management (GPEM)" course, a university program in which she studied business administration and economics entirely in English, online. She worked hard with other students who aim to become international professionals.

In addition to making full use of the university system, Minemura also experienced an internship on her own. Currently, she is engaged in activities on earthquake disaster restoration support NPO that operates mainly in Ishinomaki City, Miyagi Prefecture while focusing her research. Her stance in that is both global and local.

"I want to make the most of my horizontal and vertical connections and always be aware of what drives me as I work to solve social issues. As a researcher, I am searching for ways to solve social issues, and as an educator, I am nurturing players who will work to solve social issues. I hope to contribute to society through both of these efforts."

Internship at NPO Japan Heart (Cambodia)

Global education and research environment

Diverse study abroad programs

Global Learning Center ▶
https://www.insc.tohoku.ac.jp/english/

Tohoku University offers a variety of overseas training and study abroad programs. The following are some examples.

- **Exchange Programs**: This system allows students to study abroad for a semester or a year at an overseas university that has an academic exchange agreement with Tohoku University. Students spend a part of their student life at an overseas university, taking courses and conducting research together with local students.
- **SAP/Study Abroad Program**: This is a short-term study program during the summer and spring breaks. Students work on thematic studies, improve practical language and communication skills, and deepen their understanding of their theme.
- **High School Bridging Program**: This first-of-its-kind program at a national university in Japan is a short-term training program for high school students who have already been admitted to the university through recommendation-based Admission Office Entrance Examination, etc. Through classes, field trips, and the like at partner schools, students will develop a global mindset.

Global Gateway 04

Connecting Local Regions with Overseas Countries and Taking on the Challenge of Local Development in a Global Era

Drawing on experience at Tohoku University, Takako Honda aims to contribute to regional development by directly connecting local regions with overseas countries. She does this at JETRO, which utilizes a network of 49 domestic and 76 overseas offices to support the overseas expansion of Japanese companies and the export of agriculture, forestry, fisheries, and food products.

Takako Honda joined the Japan External Trade Organization (JETRO) after graduating from Tohoku University's Faculty of Education in 2016, and she currently works in the Digital Marketing Department's Platform Business Section, where she assists Japanese companies in promoting their products on overseas e-commerce sites.

Honda had originally hoped to work in education and regional revitalization as a public servant. However, after entering Tohoku University, she came to view not only Japan but also to the greater world. "Upon entering Tohoku University, I moved into the University House. It is a cross-cultural student dormitory run by the university, where Japanese students and international students live together under one roof. As I came into contact with the international students there, I developed an interest in cross-cultural and international exchange and a desire to actually deepen my studies abroad."

She put that idea into action right away. In her second year of university, she took advantage of Tohoku University's short-term overseas training, the Study Abroad Program (SAP), and studied abroad for about five weeks at the University of Sydney in Australia. In her third year of university, she spent 10 days in Cambodia as part of the Cabinet Office's Kizuna Project, and then studied for about a year at Uppsala University in Sweden through Tohoku University's exchange programs.

"In Australia, I had a hard time communicating in English. After returning to Japan, I worked hard to further improve my English skills by attending lectures with international students and participating as a supporter for accepting international students, and my language skills had improved by the time I studied abroad in Sweden."

During her year in Sweden, where she studied topics such as lifelong learning sustainability, Honda gained many things in addition to academic achievements. "I worked on projects with people from diverse backgrounds and nationalities. And I survived in a different culture that was completely new to me, building relationships with people, expanding my

(Left) JETRO Japan Pavilion in Bangkok, Thailand in 2017 / (Right) JETRO Rabat Office in Morocco during her assignment there

activities, and having fun. Such experience is irreplaceable, and I feel that it has certainly served me well in various aspects of my activities at JETRO over the past seven years or so."

In addition to working at JETRO's Tokyo Head Office, Honda has been posted to the Rabat Office in Morocco and the Ehime Office in Japan, where she has been promoting activities that contribute to the economic development of both Japanese regions and overseas locations. Those include promoting the overseas expansion of Japanese companies and exports of local products while interacting directly with local people as well as supporting the utilization of highly skilled foreign human resources.

"I entered Tohoku University in 2011, the year of the Great East Japan Earthquake. In my involvement in volunteer activities after the disaster, I was reminded of the importance of having a livelihood and sustainable economic development. Without economic development, the lifestyle and culture there will eventually be lost. This applies for the whole world, not just Japan. In order to also protect and further develop the unique culture of each region, I would like to link Japan's regions with the rest of the world to invigorate industry and develop the economy."

Takako Honda (Japan External Trade Organization (JETRO)/ Graduated from Tohoku University's Faculty of Education)

Global education and research environment

Cross-cultural student dormitory "University House"

The University House (UH) is a cross-cultural student dormitory based on the concept of "developing an international outlook" and "cultivating cooperation and sociability." It is the largest of its kind in Japan. At UH, Japanese and international students develop an international outlook and through daily interactions, deepening cross-cultural understanding. In addition, senior students are assigned as advisors to help new residents (new students) lead a smooth life at UH, and exchange events and the like are planned and implemented.

University House at Tohoku University ▶ https://sup.bureau.tohoku.ac.jp/en/pre-arrival-e/find-a-place-e/uh-e/

Creating Startups That Drive Social Change

Tohoku University strongly supports entrepreneurs who take on the challenge of overcoming difficulties and delivering value to society, based on their own intellectual curiosity.


101 Things I Learned in Product Design School
アメリカ発明史
世界に一番美しい「もの」のしくみ図鑑
HANDS
起業の科学
THE STARTUP MANUAL
ビジネスモデルナビゲーター
デザインの伝え方
アイデアを組織に広めるための48のパターン
ハッカソンの作り方
行動を変えるデザイン
弱いAIのデザイン
ユーザーインタビューをはじめよう
社会実装

Startup Entrepreneur

01

Toward the Realization of a Circular Economy That Utilizes Unused Biomass Resources

Phytochem Products Inc. extracts plant-based functional ingredients such as super vitamin E, available as reagents for research and dietary supplements, from unused oil generated in the rice bran manufacturing process. Its basic technology is the ion exchange resin method.Phytochem Products is working to create a virtuous cycle of resources and economy as well as a healthy life for people by integrating operations from research and development to manufacturing and sales.

[Expected Social Effects]

- **Implementation of recycling by extracting functional ingredients from unused biomass resources**
- **Contribution to a healthy life through super vitamin E products derived from rice bran**
- **Sharing of technology developed by Tohoku University with the world to become a key player in Open Innovation**

Jun. 2018	Established Phytochem Products Inc.
Nov. 2020	Selected for J-startup TOHOKU
Jan. 2021	Started sales of reagents from FUJIFILM Wako Pure Chemical Corporation
Jun. 2021	Launched “Okome no kimochi,” a super vitamin E supplement
Dec. 2022	CAS was registered for plant-based paraffin and started sales in Japan and overseas
Jan. 2023	Awarded the Excellence Prize at the Ninth Monodzukuri Nippon Grand Award
Around 2025	A mass production plant to be commissioned

In 2005, Kitakawa discovered that ion exchange resins, which are commonly used as separators in water treatment, have high catalytic activity in oil. She achieved the world's first production of biodiesel fuel (fatty acid esters) using an ion exchange resin as a solid catalyst, which attracted much attention. While working on practical implementation of this technology, including the development of a mass production system, she encountered a new topic of a highly efficient recovery of vitamin E from unused oil.

"The rice bran oil production process generates a large amount of unused oil. This oil contains useful components such as tocotrienols, but there is no way to efficiently and economically recover them, so most of it has been discarded. Tocotrienol, called super vitamin E, has 50 times the antioxidant power of tocopherol (vitamin E). We found that tocotrienol is absorbed into the resin when the unused oil is passed through the ion exchange resin column. Based on this phenomenon, we developed an efficient recovery method of tocotrienol with a low amount of impurities," says Kitakawa.

This green innovation technology, which achieves economic and resource recycling, won the GSC(Green Sustainable Chemistry) Award. The following year, Kitakawa founded Phytochem Products Inc., a start-up company from Tohoku University.

She chose Makiko Kato, a former student of hers and a plant engineer, as her business partner. She had been involved in designing equipment for a food factory at a private company, but after returning to Miyagi Prefecture, she had no place to use her skills, and her life was focused on raising her children. Kitakawa recruited her as a researcher, saying, "It would be a waste not to use your skills; you know how to convert and scale up the discovery and technology from the laboratory to the industrial level." Kato says, "At that time, Kitakawa was building larger and larger equipment in her laboratory. I was happy to contribute in any way I could."

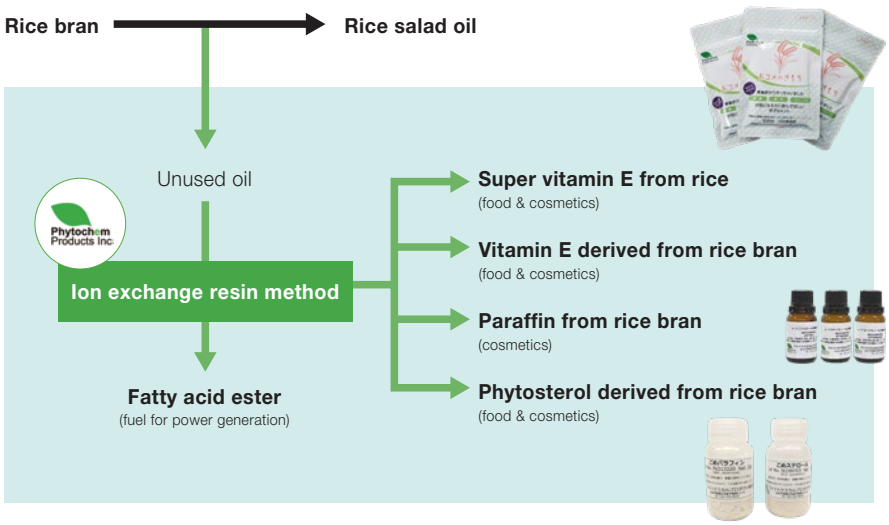
The main business of Phytochem Products' business is the sale of super vitamin E reagents. Target customers are university laboratories, and laboratories of food and cosmetic companies. The ion exchange resin method enables to reduce production cost at less than one-twentieth of conventional ones. Our product is derived from non-GMO domestic rice bran, which is also a breakthrough. Now they are planning to build a plant with 50 times the current production capacity to meet the large volume of orders for food and cosmetic raw materials.

Another product for the general public is "Okome no kimochi,"a super vitamin E supplement derived from rice bran. Super vitamin E is reported to improved skin condition and hair elasticity.

In addition, this technology can be applied to any waste oil from sources other than rice bran, according to Kitakawa. "Japan imports 2.5 million tons of edible oil annually, but only about 400,000 tons of used waste oil is recovered, of which 120,000 tons is exported and converted into jet fuel, which is then reimported. We want to break this cycle of contradiction and waste. We would like to propose the use our technology to create a resource recycling system; we can fully utilize the functional components in domestic waste oil and the remaining oil is also available for power generation and fuel. In the future, we plan to expand the technology to the palm industry overseas as an environmental measure to increase the amount of resources without expanding agricultural land by recycling waste oil."

Kitakawa's goal is to complete the process from research to mass production within the university and make it widely available to companies. "If we can share our technology with the world, it will bring great benefits to the university and stimulate future research."

Existing industry: Rice bran oil manufacturing



Phytochem Products Inc.

https://phytochem-products.co.jp/en/

Startup Entrepreneur

02

Creation of a new Spine Health-Tech Market

The main feature is a small device called the “Spine Meter,” which allows the shape of the spine to become “visible.”
This comes with an IoT app that encourages the wearer to maintain good posture when using it.
From an idea conceived as a student, this is opening up a new category in the health market by utilizing sensing technology.

[Expected Social Effects]

- **Resolution of the “military neck problem” through daily posture monitoring**
- **Contribution to the maintenance and improvement of spine health based on medical evidence**
- **Utilization of sensing technology to visualize and improve various disease risks**

Be driven by curiosity, and enjoy the process that leads to the results. Yusei Takahashi joined “natural science,” an NPO that operates based on this philosophy, in his first year at Tohoku University’s School of Engineering, where he was involved in science and technology courses for elementary, junior high, and high school students. He also conducted activities to give shape to his own ideas.

Takahashi was a member of the team that won the Japan preliminary of the 6th International Contest of Applications in Nano-Micro Technologies (iCAN‘15), a competition in which students compete in monozukuri (manufacturing) based on sensing technology, with Anywhere SADO, a tea ceremony utensil that enables optimal preparation. Furthermore, as a senior undergraduate student in 2017, he successfully won the iCAN’17 contest with his military neck problem solving application, Self Neck Corrector. In October 2020, Takahashi developed this technology through industry-academia cooperation with the School of Engineering and School of Medicine, and established weCAN inc., a startup that creates new business, with the Spine Meter as its core technology.

“Military neck is a posture in which the neck extends forward, and is believed to potentially cause a variety of physical ailments,” says Takahashi. “The device measures viewing distance and head tilt angle, and estimates each angle of the spine, thereby monitoring seated posture and encouraging the user to maintain good form. The greatest technical feature is the algorithm that estimates the shape of the spine in real time.”

[Supervised by Tohoku University School of Medicine]

Spine Meter, a glasses attachment that measures the shape of the spine

Yusei Takahashi, President, weCAN. inc.

The acquisition of time-series data, which could previously only be measured at a given instant in time by X-ray equipment at hospitals, is groundbreaking. The inspiration for Takahashi's research came from the usual scene of science and technology courses. "I was concerned about the very poor posture of children using computers and smartphones. With the recent increase in the use of information devices for remote work and the like, an increasing number of people are suffering from military neck. So, we wanted to link the results of our research to larger social activities."

His direct impetus for starting a company was winning first place in the Campus Venture Grand Prix in February 2020. He learned from the orthopedic surgery at Tohoku University Hospital that the causal relationship between posture and physical condition had not yet been verified. Takahashi then filed a patent application for innovative technology in joint research with the School of Medicine, and upgraded the device with research funding from MEXT's Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program (COI STREAM). Currently, he is verifying the medical evidence and developing a prototype as an R&D version of the Spine Meter package, which he is distributing to some academic and private organizations for a fee. Takahashi plans further research and fundraising during FY2023 to develop a product for the general public.

"The health market exists because everyone wants to be healthy and improve their quality of life. We want to develop a spine health market. By popularizing spine health-oriented products, we hope to ride the next big wave that will come in health tech after metabolic syndrome solutions and brain training," he says.

Takahashi also has another dream – to elicit children's intellectual curiosity and scientific thinking, and nurture their ability for manufacturing. Through his personal experience, he believes that the future of science and technology lies in presenting the concepts generated from our surroundings at contests, and pursuing the potential for application and development in research fields and industry.

weCAN_	Oct. 2020	Launched weCAN. inc.
	Jun. 2021	Developed Spine Meter prototype
	Late 2023	Development of software version
weCAN. inc.	Within 2024	Start of sales of the Spine Meter application for companies
	2024 onwards	Research and development of a second product to create a spine health market

Startup Entrepreneur

03

Social Implementation of Reference-Based AI Technology. A Role Model for Student Entrepreneurship

Adansons is a startup utilizing a unique “reference-based AI” that removes and detects specific signals and conducts analysis in real time. The company handles complex data such as vibration and sound, magnetic fields, tactile sensation, smell, and vital data, and provides data analysis services in the medical, manufacturing sites, and automotive fields.

[Expected Social Effects]

- **Contribution to productivity by identifying human and mechanical issues in factories**
- **Monitoring and improvement of car’s autonomous driving AI**
- **Improvement of medical imaging and hygiene data analysis**

Haruki Ishii, CEO, Adansons Inc. / 2nd-year master’s student, Graduate School of Engineering, Tohoku University

Apr. 2016	Enrolled in the School of Engineering, Tohoku University
Jun. 2019	Launched Adansons Inc.
Apr. 2022	Released AI development platform for sensor data using reference-based AI
Apr. 2023	Released performance monitoring and debugging software for autonomous driving AI
Around 2027	Aiming to be the world's most trusted AI-human interface

Performance monitoring and debugging software for autonomous driving AI from Adansons

Haruki Ishii chose the School of Engineering at Tohoku University in order to become a researcher in materials engineering. He learned that the results of excellent research techniques can remain buried without sufficient funding and the right business channels. “If the results are not utilized in society, there is no motivation to research. With this in mind, I became interested in practical implementations of research results and the securing of research funding by entrepreneurs. Research seeds alone do not form a business. They are merely the core of product value, one of the multiple components that make up a business. I felt strongly that we should delve into technology while emphasizing verification of business hypotheses and products,” says Ishii.

In his third year of as an undergraduate, he launched TUP Inc. to speedily commercialize university intellectual property. Ishii participated in the Biodesign Program at Tohoku University Hospital, which fosters talent capable of leading technological innovation in medical devices. Here, he came in touch with reference-based AI, a technology developed by Yoshitaka Kimura, Professor Emeritus of the Graduate School of Medicine, and launched the startup Adansons in the belief that it could help communities. Reference-based AI is a new machine learning algorithm that can learn by incorporating human intent and correlated data. It is used in mission-critical areas such as medicine and manufacturing because it is noise-resistant, error-resistant, and interpretable. For example, Reference-based AI can measure in real time the heartbeat of a fetus in isolation from among the various noises obtained by applying ultrasound waves to the mother's abdomen. Yushi Nakaya, an AI researcher in the School of Engineering, has been appointed as CTO, and Professor Kimura has been designated as director and technical advisor.

While everyone recognizes the added value of AI technology in the context of solving factory manpower shortages and improving efficiency, the current situation is that the process by which it makes decisions suffers from the “black box problem,” leading to anxiety on the part of the users. In addition, processing image and audio data for training AI requires a lot of human work, which is extremely costly. Reference-based AI has greatly reduced the time and effort required for this.

Adansons has developed a technology to detect human and mechanical failures by applying reference-based AI to analyze human biometric data and machine sound/vibration data. The real-time and high-quality data analysis technology has attracted attention, and the company is already providing licenses and implementation support in various industries, such as monitoring the health of factory workers and detecting abnormalities in operating machinery.

“Our current focus is on the automotive field, where we are monitoring and improving the performance of AI in autonomous driving. In other words, our AI evaluates and improves AI performance. Other companies are making similar initiatives, but our strength is real-time analysis and correction. This will prevent accidents caused by AI recognition errors and contribute to the realization of so-called Level 4 autonomous driving, with the aim of reducing fatal accidents. In addition to autonomous driving, similar demand exists in medical diagnostic imaging, analysis of hygiene data, etc. We would like to contribute to creating business impact, such as though AI applications functioning appropriately to save lives,” says Ishii.

“In starting the business, we received various kinds of support in the form of know-how from the university. The shared office for startups on the Aobayama campus is a valuable place for information exchange and acquiring the right mindset. In the future, we would like to build an interface between humans and AI. We hope to be a role model for students to commercialize the advanced technologies of professors, and for startups to take advantage of the university's resources.”

Adansons Inc.

https://adansons.co.jp/en/index.html

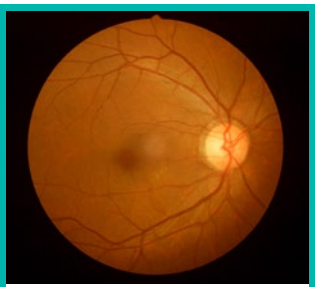
Reference-based AI

A new machine learning algorithm that enables the world's first concept of a “reference-based AI,” which can incorporate human intent and correlated data in learning

- **AI with significant reduction in preprocessing costs, training time of about 1/10th of conventional tools**
- **High-precision feature extraction from real data, especially noisy time-series data, and real-time analysis**
- **International patent pending**

Application examples

Fetal health diagnosis



Prediction of disease progression from eye-fundus images

Electricity demand forecasting

Employee near-miss detection and prediction

Summary of Financial Report

In this section we illustrate Tohoku University's financial report. The financial statements for a national university corporation in Japan are different than the financial statements and framework used for a regular, for-profit company. To facilitate the understanding of our stakeholders, we have provisionally calculated, and made available, financial statements conforming to corporate accounting, in addition to financial statements that comply with accounting standards for national university corporations.

Illustrating the Financial Position of Tohoku University

Balance sheet

(Unit: Millions of yen)

Item	FY2022 As of March 31, 2023	FY2021 As of March 31, 2022	Change from previous year	
Assets				
(Non-current assets)	335,529	338,787	(3,258)	
Land	122,125	122,125	0	
Buildings	136,286	142,604	(6,318)	
Machinery and equipment	26,291	27,024	(733)	
Books/Work of art	26,799	27,273	(474)	
Investment securities	12,038	12,384	(346)	
Shares of subsidiaries and associates	6,544	4,697	1,847	
Reserved assets	700	0	700	
(Reserved assets for depreciation	450	0	450)	
(Reserved assets for redemption of university bonds	250	0	250)	*1
Other	4,743	2,677	2,066	
(Current assets)	71,823	62,813	9,010	
Cash and deposits	56,961	47,745	9,216	*1
Accounts receivable	13,412	13,936	(524)	
Securities (Redeemable within one year)	524	171	353	
Other	925	960	(35)	
Total (Assets)	407,352	401,601	5,751	

Item	FY2022 As of March 31, 2023	FY2021 As of March 31, 2022	Change from previous year	
Liabilities				
(Non-current liabilities)	56,784	104,397	(47,613)	
Deferred inflow of assets	0	54,101	(54,101)	*3
Long-term deferred grants	14,210	15,764	(1,554)	
Long-term borrowings	22,209	23,654	(1,445)	
University bonds	10,000	0	10,000	*1
Other	10,364	10,877	(513)	
(Current liabilities)	55,579	53,993	1,586	
Deferred inflow of grants for operations	3,381	0	3,381	*4
Deferred inflow of donations	17,781	17,062	719	*4
Accounts payable	18,062	20,816	(2,754)	
Other	16,354	16,113	241	
Total (Liabilities)	112,363	158,390	(46,027)	
Net assets				
Capital	192,192	192,192	0	
Capital surplus	12,178	13,963	(1,785)	
(Capital surplus	143,507	139,556	3,950)	
(Accumulated depreciation expenses included in capital surplus	(128,537)	(122,680)	(5,856))	*5
(Accumulated profit and loss from securities included in capital surplus)	(2,791)	(2,912)	120)	*5
Earned surplus	90,598	37,054	53,544	
(Gross profit	57,415	9,866	47,549)	
Other	19	0	19	
Total (Net assets)	294,988	243,210	51,778	
Total (Liabilities, Net assets)	407,352	401,601	5,751	

*Amounts are rounded down to the nearest million, so the total amounts may not necessarily match. (The same applies hereinafter throughout the summary of financial report.)

The balance sheet presents information about Tohoku University's financial position on the reporting date (March 31) by presenting assets, liabilities, and net assets.

The key issue for the balance sheet in FY2022 was that in February 2023, Tohoku University raised funds by issuing its first university bond (named “Tohoku University Future-Creation Bond”) in the form of a 10 billion yen Sustainability Bond with a maturity of 40 years. To provide against the future redemption of university bonds, we have recorded a new “Reserved assets for redemption of university bonds” item, and will systematically put aside funds for redemption. (*1)

The income statement presents information about the University's financial performance during the reporting period by stating all of its revenues and expenses.

The key issue for the income statement in FY2022 was that revenue from sponsored research, etc., increased due to new initiatives for industry cooperation, such as the establishing of co-creation research centers and the receipt of academic contribution fees, which resulted in a significant expansion of joint research with the private sector. (*2)

In addition, revisions to the accounting standards for national university corporations led to the revoking of “Deferred inflow of assets,” which is an accounting treatment peculiar to national university corporations that was intended to equalize the impact of non-current assets on profits and losses. Accordingly, the entire balance for that item of 54.1 billion yen was recorded in extraordinary profit, which led to a substantial increase in extraordinary profit for FY2022. (*3)

National university corporations are public institutions that conduct education and research activities funded in part by the taxes paid by citizens, and unlike commercial companies, they do not aim to raise profit. For this reason, unique accounting treatments are applied that are different than those for general corporate accounting. These include temporarily recording part of revenue as liabilities before recognizing it as revenue (*4) in accordance with the prescribed rules, and deducting part of depreciation directly from net assets without recording it as an expense, etc. (*5)

Increase in the size of the business resulting from progress in diversification of funding sources

Income Statement

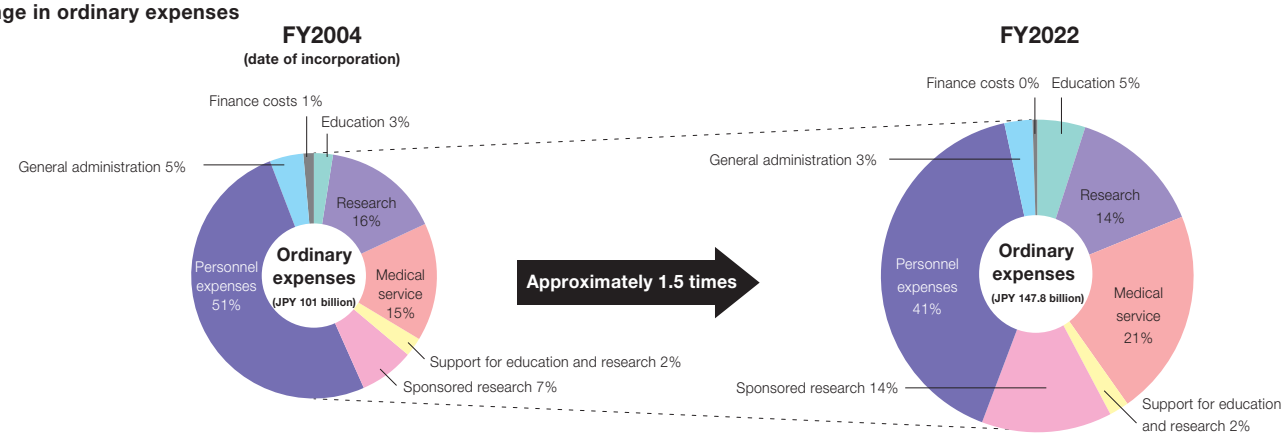
(Unit: Millions of yen)

Item	FY2022 From April 1, 2022, to March 31, 2023	FY2021 From April 1, 2021, to March 31, 2022	Change from previous year
Ordinary expenses			
Education	7,350	6,105	1,245
Research	20,477	23,114	(2,637)
Medical service	31,613	28,408	3,205
Support for education and research	3,014	2,456	558
Sponsored research	19,936	19,924	12
Personnel expenses	60,400	60,534	(134)
General administration	4,296	3,987	309
Finance costs	713	805	(92)
Ordinary expenses total	147,803	145,336	2,467
Extraordinary loss	1,630	1,116	514
Gross profit	57,415	9,866	47,549

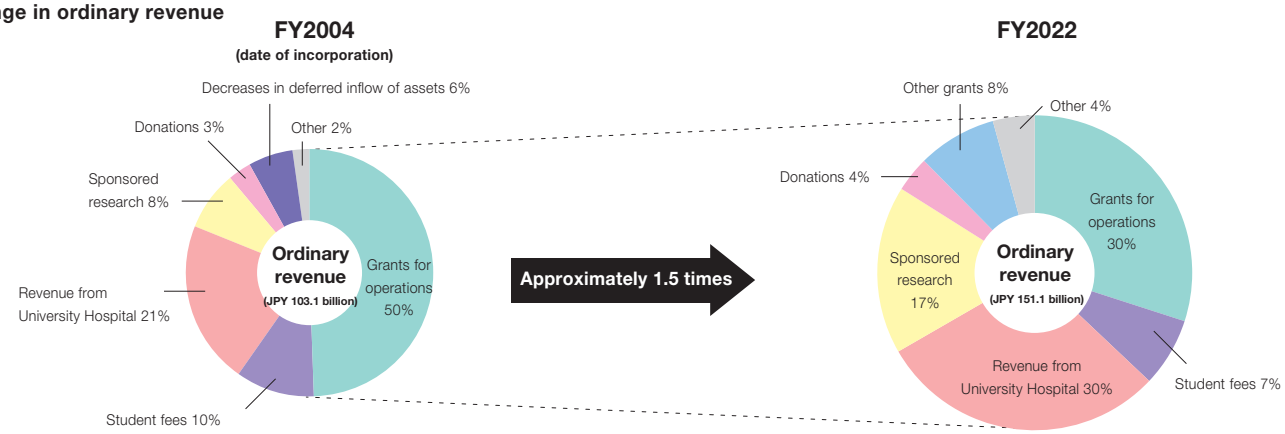
Item	FY2022 From April 1, 2022, to March 31, 2023	FY2021 From April 1, 2021, to March 31, 2022	Change from previous year
Ordinary revenue			
Grants for operations	45,313	44,684	629
Student fees	10,695	10,659	36
Revenue from University Hospital	44,789	43,612	1,177
Sponsored research	26,119	25,298	821 *2
Donations	5,527	2,635	2,892
Other grants	12,255	14,151	(1,896)
Decreases in deferred inflow of assets	0	6,559	(6,559) *3
Other	6,489	5,642	847
Ordinary revenue total	151,189	153,243	(2,054)
Extraordinary profit	54,166	2,499	51,667 *3
Reversal of reserve for specific purposes	1,493	575	918

[Change in Size of Business]

Change in ordinary expenses



Change in ordinary revenue



As a result of actively promoting the diversification of our funding sources, external funding such as sponsored research, and revenue from the University Hospital have increased significantly since incorporation in 2004, and there has been a growth in the size of business of approximately 1.5 times as a whole.

Using Provisional Calculations to Visualize Tohoku University's Summary of Financial Report

In this section we review and discuss the issues facing Tohoku University, using provisional calculations of financial statements conforming to corporate accounting.

Balance sheet before restatement

Balance sheet (FY2022)

(Unit: Millions of yen)

Assets	
(Non-current assets)	335,529
Land	122,125
Buildings	136,286
Machinery and equipment	26,291
Books/Work of art	26,799
Other	24,026
(Current assets)	71,823
Cash and deposits	56,961
Accounts receivable	13,412
Other	1,449
Total (Assets)	407,352
Liabilities	
(Non-current liabilities)	56,784
Long-term deferred grants	14,210
Long-term borrowings	22,209
Provisions	956
Other	19,408
(Current liabilities)	55,579
Deferred inflow of grants for operations	3,381
Deferred inflow of donations	17,781
Deferred inflow of sponsored research	5,230
Long-term borrowings	3,406
Accounts payable	18,062
Provisions	1,034
Other	6,682
Total (Liabilities)	112,363
Net assets	
Capital	192,192
Capital surplus	12,178
(Capital surplus	143,507)
(Accumulated depreciation expenses included in capital surplus	(128,537))
(Accumulated profit and loss from securities included in capital surplus	(2,791))
Earned surplus	90,598
(Gross profit	**57,415)**
Other	19
Total (Net assets)	294,988
Total (Liabilities, Net assets)	407,352

Balance sheet after restatement

Provisionally calculated financial statements conforming to corporate accounting (FY2022)

(Unit: Millions of yen)

Item	Whole University	Education and research business	Externally funded business	Hospital and medical service business
Assets				
(Non-current assets)	335,529	264,272	34,145	37,111
Land	122,125	114,629	-	7,496
Buildings	136,286	100,749	12,985	22,551
Machinery and equipment	26,291	11,529	7,835	6,925
Books/Work of art	26,799	26,243	543	11
Other	24,026	11,120	12,780	126
(Current assets)	71,823	40,793	14,230	16,798
Cash and deposits	56,961	39,124	10,010	7,826
Accounts receivable	13,412	1,202	3,623	8,586
Other	1,449	467	596	385
Total (Assets)	407,352	305,066	48,375	53,910
Liabilities				
(Non-current liabilities)	71,617	40,925	1,187	29,503
Long-term borrowings	22,209	-	-	22,209
Provisions	30,004	23,785	-	6,218
Other	19,402	17,139	1,187	1,075
(Current liabilities)	37,571	17,088	11,253	9,230
Deferred inflow of grants for operations	3,326	3,326	-	-
Advances received for sponsored research	5,150	-	5,150	-
Current portion of long-term borrowings	3,406	-	-	3,406
Accounts payable	18,062	8,074	5,389	4,597
Provisions	3,196	2,310	-	885
Other	4,429	3,375	712	340
Total (Liabilities)	109,188	58,013	12,441	38,734
Net assets				
Capital	192,192	208,672	-	(16,479)
Capital surplus	134,262	118,136	-	16,125
Earned surplus	(28,310)	(79,775)	35,934	15,530
(Gross profit/loss	**(4,048)**	**(7,808)**	**4,924**	**(1,164))**
Other	19	19	-	-
Total (Net assets)	298,163	247,052	35,934	15,175
Total (Liabilities, Net assets)	407,352	305,066	48,375	53,910

The accounting system used by national university corporations is characterized by accounting treatments peculiar to such organizations and different than corporate accounting, which has led to stakeholders expressing the view that the financial statements are difficult to understand. In response to this, the University began to provisionally calculate financial statements conforming to corporate accounting to enable the substance of its summary of financial report to be understood more easily. We began provisionally calculating financial statements in FY2019 and have implemented improvements every year. This fiscal year marks the fourth time we have undertaken this initiative.

In FY2022, despite recording 57.4 billion yen in gross profit when using national university corporation accounting, the provisional calculations conforming to corporate accounting resulted in a 4.0 billion yen gross loss (a decline of 61.4 billion yen when compared to the figures before restatement). This was due mainly to extraordinary profit of 54.1 billion yen (refer to pp.68-69) arising from the revoked "Deferred inflow of assets," which was included in gross profit before restatement. An additional factor was that 5.7 billion yen in depreciation for buildings was not recognized in profits or losses under national university corporation accounting, but was recognized as an expense on the P&L after restatement in accordance with corporate accounting.

[Supplementary Information on Provisional Calculation of Financial Statements Conforming to Corporate Accounting]

- Expenses not recognized in profits or losses (such as depreciation expenses included in capital surplus) were recorded as expenses in the fiscal year under review.
- Expenses not provided for (such as provision for retirement benefits not provided for) were recorded as expenses in the fiscal year under review.
- Grants for operations and donations, etc., are not used as a balancing item to expenses executed, in order to equalize profits and losses, and as a rule, the amount of grants or the amount received for the current period is recorded as revenue.
- The reversal of reserve for specific purposes recorded as a balancing item for expenses executed in relation to the reserve for specific purposes to equalize profits and losses is reversed.
- The extraordinary profit that was recorded as a result of the abolition of deferred inflow of assets has been reversed.

(Unit: Millions of yen)

Ordinary expenses	
Education	7,350
Research	20,477
Medical service	31,613

(Unit: Millions of yen)

Through provisional calculations made in conformance with corporate accounting, the size of the impact of depreciation for facilities, etc., on the management of the University becomes clearly visible. Depreciation reduces the value of assets such as facilities every year, and grants for facilities provided by the state, which are the source of funding for upgrades, continue to be insufficient. Installing and upgrading facilities while actively diversifying funding sources to avoid being solely dependent on government funding is one of the issues faced by the University going forward.

Looking at gross profit by business, the education and research business recorded high depreciation for buildings, and because sources of funding from the state in the form of grants for operations and grants for facilities were insufficient to cover this, a gross loss of 7.8 billion yen was posted. On the other hand, the externally funded business, which is the result of the University's autonomous activities, posted a profit of 4.9 billion yen due to active efforts made to acquire external funding. By showing how insufficient funding for the education and research business is supplemented by the externally funded business, it makes the reality of the university management easier to understand.

Through a process of trial and error, we will continue to provisionally calculate financial statements conforming to corporate accounting, aiming to actively disclose information that makes our summary of financial reports easier to grasp, and hoping to gain the continued understanding and support of all our stakeholders.

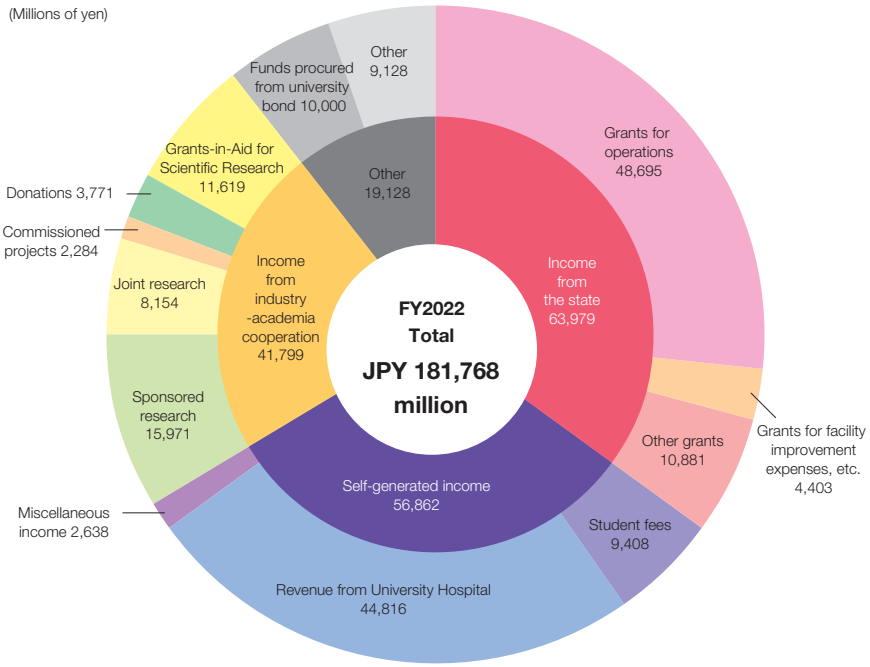
Receipts of research funding from the private sector increased due to further progress in joint research

External funds acquired from the private sector exceeded 10 billion yen.

1. Total income

The income of Tohoku University can be divided into income from the state, self-generated income, and income derived from industry cooperation. It consists of a diverse range of income sources, including grants for operations, subsidy income, income from student fees, revenue from University Hospital, income from sponsored research and joint research, and donations.

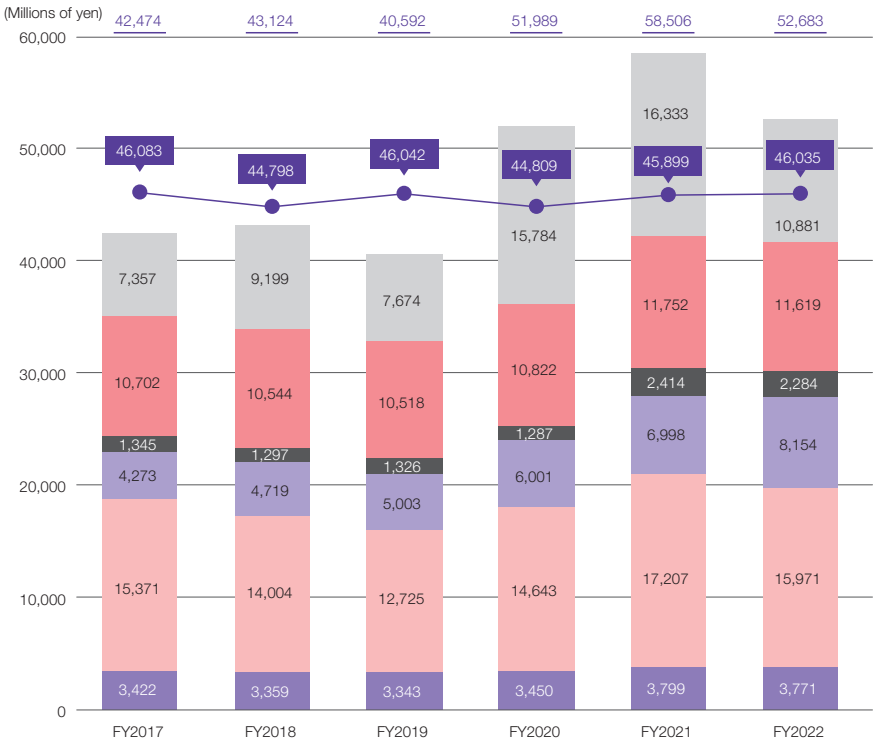
Total income in FY2022 was 181.7 billion yen, with the combination of self-generated income and income from industry cooperation, which represent the University's autonomous activities, reaching 98.6 billion yen, or 54.3% of the total income.



2. Amount of External Funding and Grants for Operations Received

Total external funding acquired in FY2022 came to 52.6 billion yen. This was around 15% higher than grants for operations received of 46.0 billion yen. In addition, looking at the breakdown of sources of funding, although there were declines in other grants compared to the previous year, which consists mostly of research funding from the state, etc., and sponsored research, there was a significant increase in joint research, which mainly comprises research funding from the private sector.

*These figures are the amounts received in the fiscal year under review as stated in the supplementary schedules to the financial statements.
Grants for operations does not include amounts related to recovery and restoration projects (2.1 billion yen in FY2021, 2.66 billion yen in FY2022).



3. Research funding from the private sector

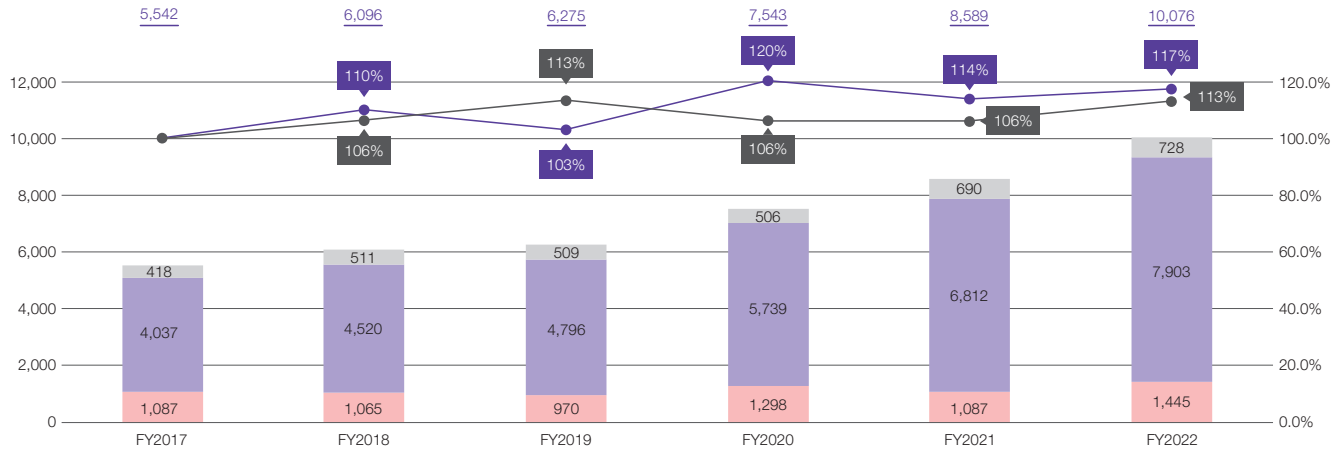
External funding acquired from the private sector has increased every year, exceeding 10 billion yen in FY2022. The rate of year-on-year growth was 17%, which exceeded the average for the seven major national universities. The expansion in joint research was particularly noticeable, and was driven by new initiatives for industry cooperation, such as the establishing of co-creation research centers and the receipt of academic contribution fees.

(Millions of yen)

	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
Sponsored research	1,087	1,065	970	1,298	1,087	1,445
Joint research	4,037	4,520	4,796	5,739	6,812	7,903
Commissioned projects	418	511	509	506	690	728
Total	5,542	6,096	6,275	7,543	8,589	10,076
Year-on-year growth rate (Tohoku University)	-	110%	103%	120%	114%	117%
Year-on-year growth rate (Average for seven universities)	-	106%	113%	106%	106%	113%

(Millions of yen)

Trend in acquisition of external funding from private sector



*Aggregate figure for amounts received from private sector in the areas of sponsored research, joint research, and commissioned projects

*Seven major national universities: Hokkaido University, Tohoku University, University of Tokyo, Nagoya University, Kyoto University, Osaka University, Kyushu University

Sponsored research / Joint research / Commissioned projects / Total / Year-on-year (Tohoku University) / Year-on-year (average for seven major national universities)

Credit ratings from rating agencies

The University obtains credit ratings through objective assessments by external rating agencies with the aim of increasing its creditworthiness and the transparency of management, and of diversifying methods for raising funds.

Rating agency	Ratings	Rating acquisition date
Rating and Investment Information, Inc. (R&I)	AA+	November 4, 2022 (First update)
Japan Credit Rating Agency, Ltd. (JCR)	AAA	

[Key Credit Rating Issues]

- As a designated national university corporation, our role is to drive tertiary education and research in Japan. In rankings of highly cited research papers, the University occupies a favorable position among universities, and has extraordinary capabilities in education and research.
- Based on the principles of “Research First,” “Open Doors,” and “Practice-oriented Research and Education,” we have achieved a virtuous cycle of education, research, and community collaboration.
- We have a strong international presence centered on the fields of materials science, spintronics, next-generation medicine, and disaster science.
- We have become one of the leading players in Japan in terms of acquiring external funding. We have built close relationships with industry, and in 2021 we established the co-creation research center system.
- We are working on strategic allocation of resources by securing a President's Budget, which is the largest-scale budget possible for a national university corporation.
- In addition to contributing to community health care, the University Hospital plays an important role as an organization for the training of physicians. Our strengths of cutting-edge facilities and highly ranked medical services have enabled us to achieve stable income and expenditures.

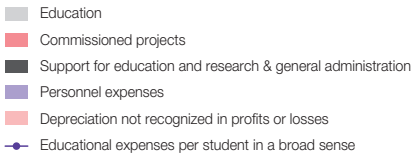
Substantial Investments in Education and Research Activities

We invest approximately 2.5 times the fee received per student

1. Educational Expenses per Student (in a Broad Sense)

This is an indicator that shows the amount of investment in educational activities per student. The higher the value, the greater the investment in educational activities per student. Tohoku University invests more than 20 billion yen annually in education-related expenses. In FY2022, this represents an investment of 1.36 million yen per student, which is approximately 2.5 times the student fees (535,800 yen per year).

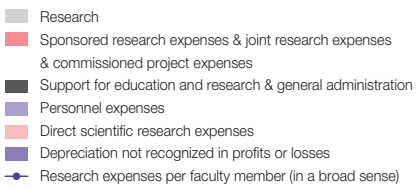
[Educational Expenses per Student (in a Broad Sense)]
(Expenses for education + commissioned project expenses + expenses related to supporting for education and research & general administration + personnel expenses + depreciation not recognized in profits or losses) ÷ number of students
It represents educational costs incurred per student. These are calculated through the pro-rated addition of personnel expenses for faculty/staff, administration and operational costs, and other costs to the "Education" item of the income statement.

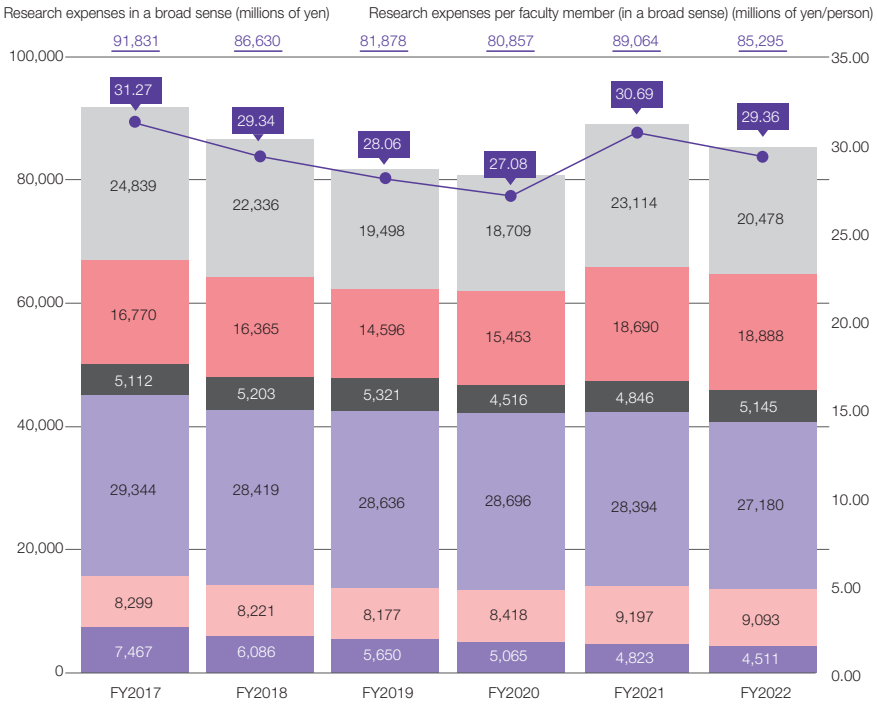


2. Research Expenses per Faculty Member (in a Broad Sense)

This is an indicator that shows the investment in research activities per faculty member. The higher the value, the greater the investment for research activities per faculty member. On a per-faculty member basis, Tohoku University invests an average of around 30 million yen per year in research activities.

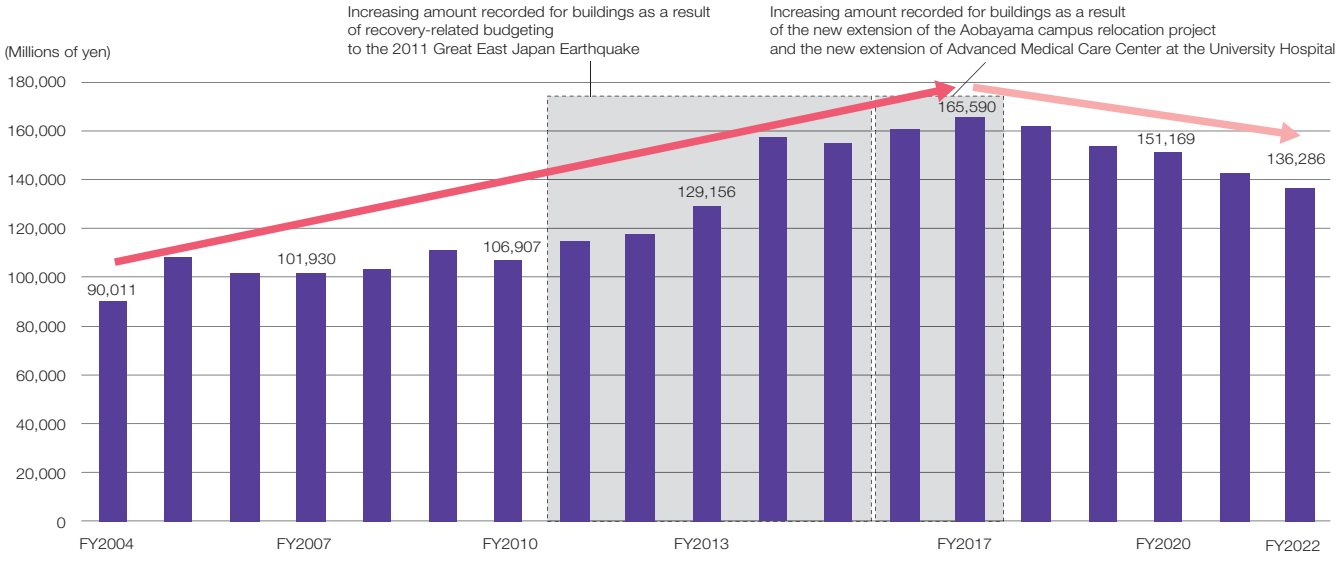
[Research Expenses per Faculty Member (in a Broad Sense)]
(Expenses for research + sponsored research expenses & joint research expenses & commissioned project expenses + expenses related to supporting for education and research & general administration expenses + personnel expenses + direct scientific research expenses + depreciation not recognized in profits or losses) ÷ full-time faculty members
It represents research costs incurred per faculty member. These are calculated through the pro-rated addition of personnel expenses for faculty/staff, administration and operational costs, and other costs to the "Research" item of the income statement.





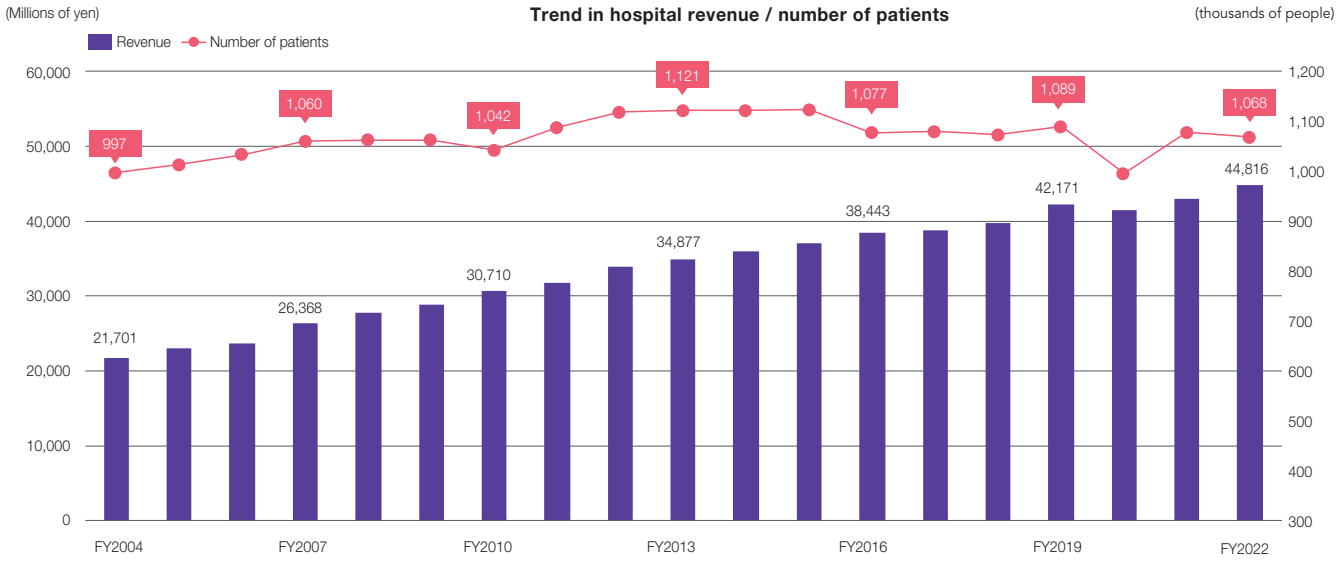
3. Amount Recorded for Buildings

After the incorporation of national universities in 2004, the value of assets such as buildings rose steadily, due to factors that include earthquake recovery-related budgeting, and the campus relocation project. This peaked in FY2017 at approximately 1.8 times (90 billion yen → 165.5 billion yen), but in recent years, new facility improvement projects have been on a downward trend, which has resulted in depreciation exceeding the amount spent on acquiring new assets, and turn to a reduction in the amount recorded for buildings.



4. University Hospital

The University Hospital is a place for developing and practicing cutting-edge medicine, whose mission is to apply this knowledge so as to generate returns for the general public. To enable the fulfillment of this mission, strengthening the Hospital's financial base so that it is able to secure large numbers of outstanding talent and install cutting-edge medical facilities has become an urgent matter, and we are taking various steps to reduce expenses while making efforts to increase revenue.



Forging the Path to a Better Future, Hand in Hand with Society

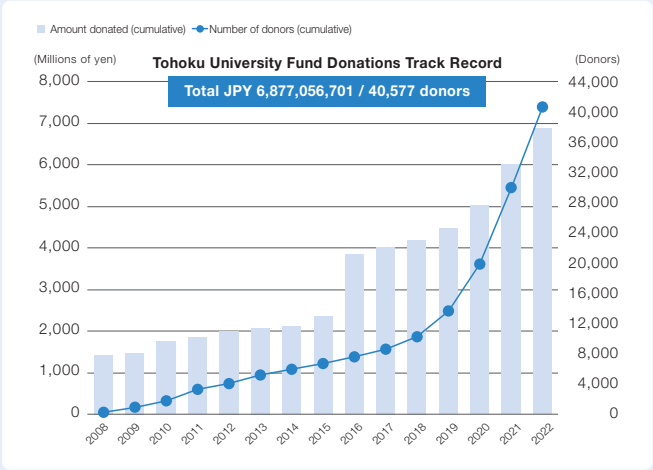
Working hand in hand with society is essential to the University's identity.
We are committed to advancing various activities with everyone's support.
The fund is a reflection of the great hopes and support of the University.
By working hand in hand with everyone, Tohoku University will continue forging the path to a more prosperous future.

FY2022
Donations to the Tohoku University Fund

Total amount donated: JPY 876,074,051
Number of donors: 10,628

(Breakdown) Individuals: 10,406, Corporations and organizations: 222

https://www.bureau.tohoku.ac.jp/kikin/english/



Giving Support Together: Providing Support to Students and Academics for International Exchange

With the help of our supporters, we are able to provide a wide range of assistance to help students develop a global perspective, including support to study abroad and other financial aid.

Tohoku University Fund Global Hagi Scholarship to Study Abroad

Providing support to outstanding students for international studies, this scholarship is aimed at students who plan to study abroad for a period of no less than three months and no longer than one year.

[Support Provided]

- Support for overseas travel, living expenses, etc., associated with studying abroad
  FY2022 support track record: 21 students

Tohoku University Global Hagi Scholarship for Doctoral Students

Aimed at doctoral students, this scholarship program provides support to highly motivated and talented students to enable them to devote their time exclusively to research.

[Support Provided]

- Grant-type scholarship disbursement
  FY2022 support track record: 176 students (including 71 students supported by the Tohoku University Fund)

Taking Challenges Together: Support for Startups

Through the excellence and diversity of our research, we create research findings and future-changing social value that contribute to solving global issues and achieving a resilient society.

Startup Incubation Support

There is a growing need to create startups and creating startups that drive social change. Toward that end, Tohoku University established the “Startup Incubation Support Fund.” Donations received by this fund will be utilized for the GAP fund that supports entrepreneurship development and business feasibility studies. With everyone’s support, we will reinforce the innovation cycle of new business creation and regional revitalization.

Working Hand in Hand Together: International Support

In terms of international support, we provide support to war-torn Ukraine as well as to Turkey and Syria, where a major earthquake struck.

Support for Ukraine

We continue to provide wide-ranging assistance to Ukrainian students, researchers, etc., who have struggled to continue their studies and research due to the Russian invasion of Ukraine.

[Support Provided]

- Creation of “Ukraine Humanitarian Support Fund”
  FY2022 support track record; Number of donors: 250 Total amount donated: JPY 3,970,834
- Taking in Ukrainian students and researchers, as well as the family members of researchers at the University, and offering support for travel expenses, providing free housing, etc.
- Incorporating other means of assistance besides donations (e.g., matching donors)

Supporting Research into the Turkey-Syria Earthquake

On February 6, 2023, a major earthquake of magnitude 7.8 occurred in southeastern Turkey, causing extensive damage across a wide area. The Tohoku University International Research Institute of Disaster Science began investigating the earthquake immediately after it occurred and has been sharing the results of its analyses and investigations widely on its website and other media to support affected communities.

[Support Provided]

- Investigating and analyzing the Turkey-Syria earthquake, as well as sharing the results

Growing Together: Supporting Student Activities

Tohoku University encourages extracurricular activities as a way to cultivate sociality, independence, cooperation, and leadership, as well as to promote and improve physical and mental health. With the help of our supporters,, we successfully enhance and advance student organizations to provide a platform for various student activities.

Extracurricular Activities Support

The Tohoku University Club Association (“Gakuyu-kai”) is a university-wide organization for cultural, athletic, and other voluntary activities that will celebrate its 102nd anniversary in 2023. A total of 8,000 students participate in 187 organizations (as of February 2022), through which they achieve success in various fields, athletic competitions, etc. Tohoku University has established the Tohoku University Club Association (“Gakuyu-kai”) Support Fund with main purpose of improving the facilities for students to engage in extracurricular activities.

Stellar Student Achievements

Record-breaking fourth consecutive championship at the 61st National Seven Universities Athletic Meet (Nanadaisen)

The National Seven Universities Athletic Meet, also known as the Nanadaisen, brings together seven universities—Hokkaido University, Tohoku University, The University of Tokyo, Nagoya University, Kyoto University, Osaka University, and Kyushu University—to compete in more than 40 events and score points to win the overall championship. At the 61st meet in 2022, held for the first time in three years, Tohoku University won an unprecedented fourth consecutive championship.

Event Year	Event No.	Champion
FY2017	56th	Tohoku University
FY2018	57th	Tohoku University
FY2019	58th	Tohoku University
FY2020 and FY2021	59th/60th	Cancelled due to COVID-19
FY2022	61st	Tohoku University

First time in history to win four consecutive championships!

Tohoku University’s WHO Street Dance Circle takes first place at Japan Dancers’ Championship 2023

The WHO Street Dance Circle from Tohoku University took first place at the Japan Dancers’ Championship 2023, held on February 20, 2023, at Zepp DiverCity (Tokyo), deciding the best university dance team in Japan. The group is affiliated with the sports clubs of the Tohoku University Club Association (“Gakuyu-kai”).

Due to COVID-19, this was the first time in three years that the competition was held. By practicing hard as a single unit, the 53 members of the circle became the first regional team ever to win the championship, despite few members with competition experience and many strong private universities that competed from across Japan.

As defending champions, the group is already looking ahead to the 2023 competition and practicing harder than ever to win a second consecutive championship.

Support Your Favourite Sports Club through the Tohoku University Giving Campaign!

The Tohoku University Giving Campaign is an online charity event to support Tohoku University student organizations in a variety of ways. In addition to voting for your favorite organization, you can also show your support of our dedicated students by sending a message to cheer them on or by making a donation to their organization. From June 19-25, 2023, the Tohoku University Giving Campaign 2023 Spring garnered support and donations from 26,670 people. (Total amount donated: approximately 15 million yen.)

Tohoku University's Windnauts take first prize at the 44th Japan International Birdman Rally

At the 44th Japan International Birdman Rally on July 24, 2022, held at the Matsubara Swimming Area in Hikone City, Shiga Prefecture, Tohoku University Windnauts (officially, the Tohoku University Club Association ("Gakuyu-kai"), Human-Powered Aircraft (Birdman)) broke the team record (36,000 meters) and took first prize in the Human-Powered Aircraft (HPA) distance category with a distance of 36,868.8 meters and a time of over 1.5 hours.

Windnauts celebrates its 30th anniversary in 2023. The team name is a coined expression combining the words "wind" and "nauts" (sailors) to convey the desire to "cross the windy sea." The group works hard everyday to participate and win in the Birdman Rally.

In 2022, the Tohoku University Windnauts Support Fund was launched. With everyone's support, they will have funds to help pay for the production of their aircraft, which costs some three to four million yen each year.

Tohoku University Data

Ascertaining the actual scale and research strength, etc., of a university is complicated. Here we present some figures that provide an idea of the University's current position. We hope the information is useful.

THE Japan University Rankings 2023

Four consecutive years 1st

1st

THE World University Rankings 2023

3rd in Japan (201-250 globally)

QS World University Rankings 2023

5th in Japan (79 globally)

Universities Where Students Grow the Most After Admission

1st for three consecutive years

1st

Asahi Shimbun Publications "University Rankings 2024" Rankings by High Schools
Universities Where Students Grow the Most After Admission: 1st

Admitted through comprehensive selection

(e.g., recommendation-based Admission Office Entrance Examination)

1st among national universities

Asahi Shimbun Publications "University Rankings 2024"
Comprehensive Selection Rankings (Admitted) 13th

Featured President Reputation

1st among national universities

Asahi Shimbun Publications "University Rankings 2024"
Evaluation Rankings from University Presidents
Featured President Reputation: 3rd

Total number of students

17,685

Number of international students

3,115

FY2022 (full year)

Faculties	Graduate Schools	Associated Research Institutes	Professional Graduate Schools
10	15	6	3

Estimated annual hours of administrative work reduction through digital transformation

Over **100,000** hours

Requests for lectures and media coverage of Tohoku University digital transformation actions

76 (as of September 2023)

Selected for the Project to Establish University Fellowships of the Creation of Science and Technology Innovation
(Project term: FY2020-2027)

1st in Japan (120 people/academic year)

Moonshot Research and Development Program
Number of PM selected

2nd in Japan (9)

FY2022 JSPS Prize

2nd in Japan (3 people)

The Commendation for Science and Technology by the MEXT, The Young Scientists' Awards
(Number of awards from FY2016-2023)

2nd in Japan (78 people)

FY2022 Tohoku University Fund Donations Track Record

JPY 876,074,051 (10,628 donors)

FY2022 Grants-in-Aid for Scientific Research

JPY 10.3 billion
(2,472 awards)

FY2022 Amounts received for joint research, etc., from private company

JPY 10.076 billion

MOOC (Massive Open Online Courses)

Largest in Japan

14 courses offered (cumulative)

Open Badges issued
Over **2,700**

FORBES 30 UNDER 30 ASIA 2023

3 university graduates selected

National Seven Universities Athletic Meet (Nanadaisen)

4th consecutive championships

Tohoku University Start-ups

179 companies
(as of June 2023)

TOHOKU UNIVERSITY INTEGRATED REPORT

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