Tokyo Metropolitan Public University Corporation

Environmental Report 2024

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Editorial Policy

The purpose of this report is to provide a broad understanding of the Corporation's environmental initiatives both inside and outside Japan. This report is published in Japanese and English for stakeholders around the world and is available on our official website.

Web address: https://www.houjin-tmu.ac.jp/sustainability/

[Scope of Coverage] Tokyo Metropolitan Public University Corporation
All campuses of Tokyo Metropolitan University
All campuses of the Advanced Institute of Industrial Technology
All campuses of the Tokyo Metropolitan College of Industrial Technology
[Period Covered] Fiscal year 2023 (April 1, 2023 - March 31, 2024)
*Includes some activity reports outside the period covered.
[Date of Issue] December 2024
[Guidelines Referenced] Ministry of the Environment, "Environmental Reporting Guidelines (2018 Edition)"

Climate and Environmental Emergencies Are Educational Emergencies

Universities around the world have already been severely affected by heat waves, droughts, torrential rains, and forest fires, all of which threaten the safety and continuity of education. At the same time, it has become an urgent priority to mobilize all academic disciplines to promote research for a just and sustainable future and, above all, to foster talent for social change through climate and environmental education.

Chairperson, Tokyo Metropolitan Public University Corporation
TAMAMOTO Ryoichi

On July 6, 2023, the global average temperature reached a record high of 17.08 ° C, the highest ever recorded for a single day. However, this was quickly surpassed on July 22, 2024, when the temperature rose to 17.16 ° C. Alarmingly, for 13 consecutive months from June 2023 to June 2024, the global average temperature set new records each month. In 2023, the global average temperature was 1.45° C higher than pre-industrial levels, and 2024 may become the first year to exceed the 1.5 ° C goal of the Paris Agreement. If the 1.5 ° C threshold is breached, there is a high likelihood of crossing four critical climate tipping points in the Earth' s system. Some studies suggest that the Atlantic Meridional Overturning Circulation (AMOC) could collapse as early as 2025 or sometime around 2037. Additionally, the rapid decline in biodiversity is attributed primarily to the expansion of human activities and the increasing consumption of resources.

Faced with this climate and environmental emergency, universities around the world have begun to transform their teaching, research, and management practices. Here are some of the recent initiatives in education.

- Columbia University established the Climate School in 2020
- Utrecht University launched the USO project aimed at empowering students during the climate emergency
- Curtin University created a new faculty dedicated to the environment and climate emergency
- Cardiff University established the Centre for Climate Change and Social Transformations (CAST)
- Newcastle University introduced training on Coordination and Collaboration in the Resilience Ecosystem (CCRE)
- The University of Oxford initiated education through its Climate Emergency Programme
- Goldsmiths, University of London, developed the Green New Deal Curriculum
- Linnaeus University established the Centre for Climate Emergency Studies to provide education
- Falmouth University developed methods to integrate climate and SDGs into all curricula
- The University of Barcelona, UWE Bristol, and the University of California, San Diego made climate education a compulsory subject
- All universities in India will make climate education a compulsory subject for graduation starting in 2024
- Led by Stony Brook University, the New York Climate Exchange was established through a network of universities, businesses, and NGOs, offering education, research, and incubator training for climate solutions on Governors Island
- The University of Illinois established the Climate Jobs Institute
- The University of the Sacred Heart conducts environmental and ESD education through its Institute for Global Symbiosis
- International Christian University offers climate and environmental education as part of its liberal arts curriculum
- Tokyo Metropolitan Public University Corporation established the Sustainable Research Promotion Organization and is advancing climate and SDG education through PBL (Project-Based Learning)

There can be no research or education on a dead planet; therefore, institutions of higher education must devote their full efforts to research and education aimed at overcoming the climate and environmental emergency.

In July 2021, Tokyo Metropolitan Public University Corporation was the first national and public university in Japan to issue a Climate Emergency Declaration, followed by a Nature Positive Declaration in July 2024. Officially acknowledging the climate and environmental emergency, the Corporation recognizes its social responsibility and mission as a higher education institution to dedicate itself fully to overcoming this crisis. This report primarily summarizes the efforts and results of our educational and research activities during the 2023–2024 fiscal years. We hope you take the time to read it and gain insight into the Corporation' s efforts.

Overview

●Name	Tokyo Metropolitan Public University Corporation
●Date of Establishment	April 1, 2005
●Location	2-3-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo
●Chairperson	YAMAMOTO Ryoichi

History

●2005 Establishment of the Public University Corporation Tokyo Metropolitan University

Reorganization and integration of Tokyo Metropolitan University, the Tokyo Metropolitan Institute of Technology, the Tokyo Metropolitan University of Health Sciences, and Tokyo Metropolitan Junior College to form Tokyo Metropolitan University

●2006 Opening of the Advanced Institute of Industrial Technology

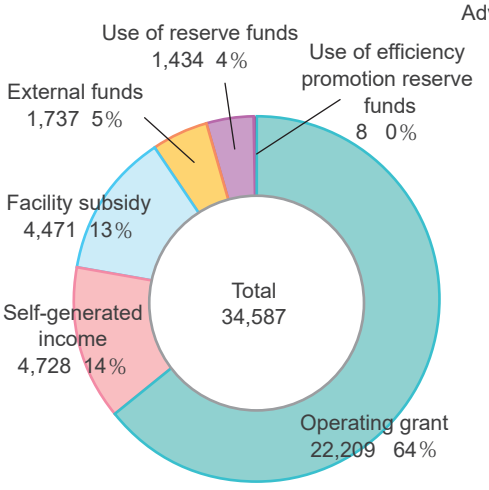
Reorganization and integration of the Tokyo Metropolitan College of Technology and Tokyo Metropolitan Aviation Technical College to form the Tokyo Metropolitan College of Industrial Technology

●2020 Renamed from Public University Corporation Tokyo Metropolitan University to Tokyo Metropolitan Public University Corporation; from Tokyo Metropolitan University (Shuto Daigaku Tokyo) to Tokyo Metropolitan University (Tokyo Toritsu Daigaku); and from the Advanced Institute of Industrial Technology to the Tokyo Metropolitan Advanced Institute of Industrial Technology

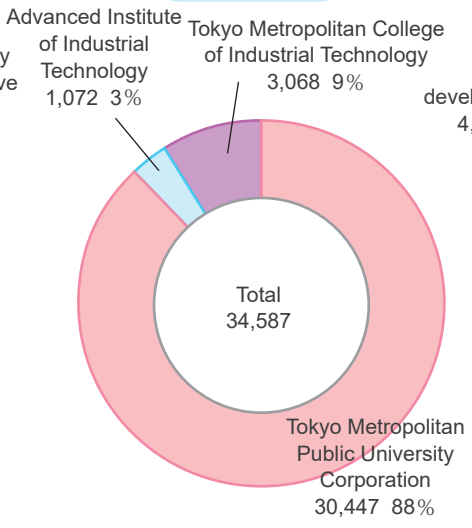
Financial Status

FY2024 Revenue Budget (Unit: Million yen)

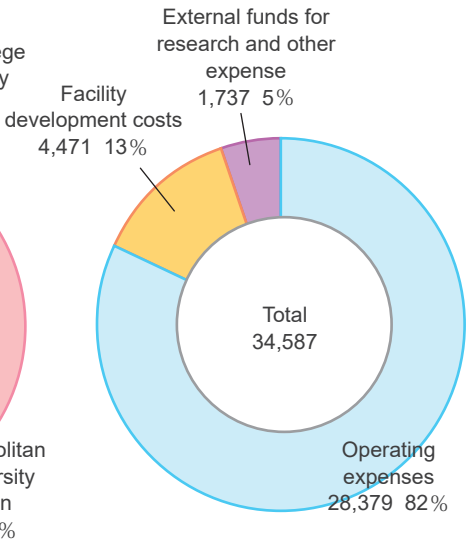
By category



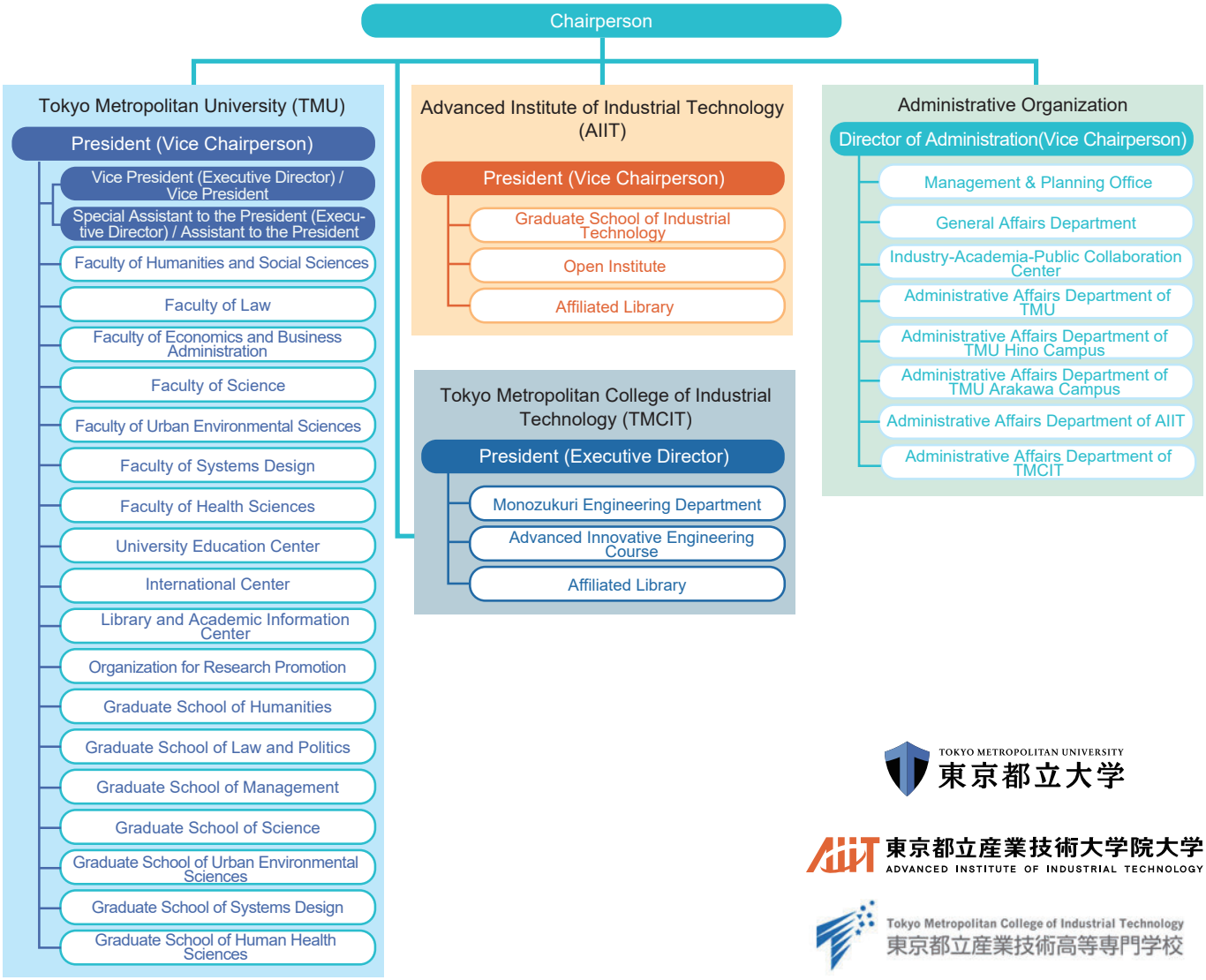
By segment



FY2024 Expenditure Budget (Unit: Million yen)



Organizational Chart



TOKYO METROPOLITAN UNIVERSITY 東京都立大学

東京都立産業技術大学院大学 ADVANCED INSTITUTE OF INDUSTRIAL TECHNOLOGY

Tokyo Metropolitan College of Industrial Technology 東京都立産業技術高等専門学校

Number of students and faculty

(As of May 1, 2024)

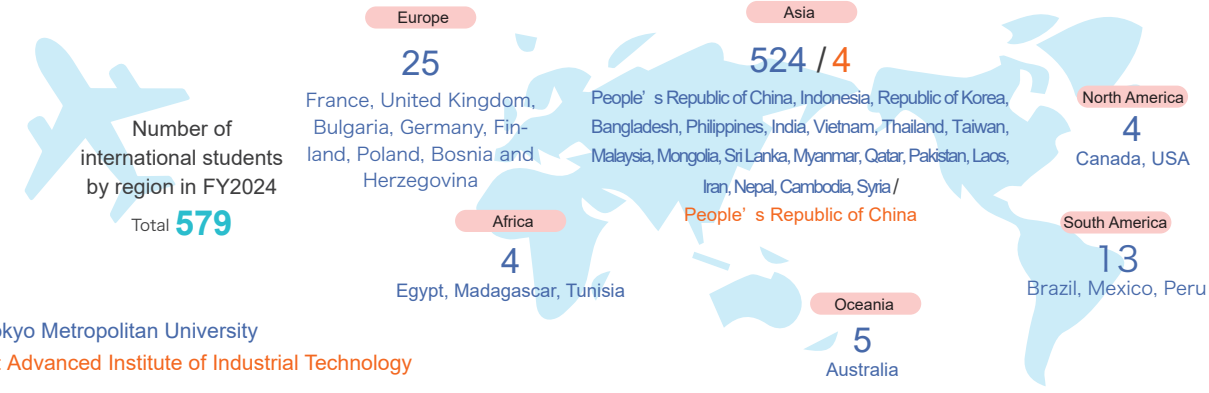
*The student numbers for Tokyo Metropolitan University (TMU) include those enrolled in the organization before the reorganization in FY2017. The staff numbers include temporary staff. Additionally, for TMU, the entire corporation (such as the Corporate Planning Office, General Affairs Department, etc.) is included.

Number of students
11,022
TMU : 9,147 students
AIIT : 230 students
TMCIT : 1,645 students

Number of faculty
798
TMU : 652 faculty members
AIIT : 27 faculty members
TMCIT : 119 faculty members

Number of staff
661
TMU : 558 staff members
AIIT : 33 staff members
TMCIT : 70 staff members

Number of international students by region in FY2024
Total **579**



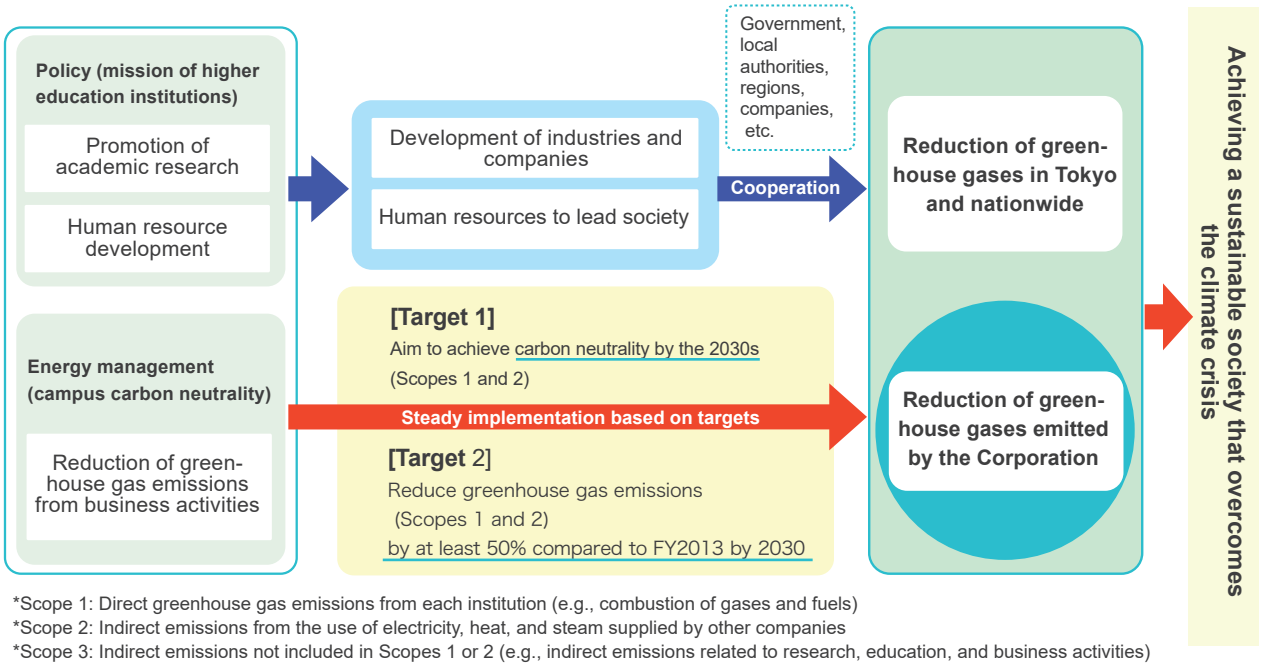
Blue: Tokyo Metropolitan University
Orange: Advanced Institute of Industrial Technology

Formulation of the Carbon Neutrality Promotion Plan

In March 2023, the Tokyo Metropolitan Public University Corporation (hereinafter referred to as the "Corporation") formulated the "Carbon Neutrality Promotion Plan," the first such plan among national and public universities, following its 2021 Climate Emergency Declaration.

The plan outlines the fundamental directions for future initiatives, clarifies the Corporation's greenhouse gas emissions, and sets a target to achieve carbon neutrality (Scopes 1 and 2) by the 2030s, exceeding the goals set by the national government and the Tokyo Metropolitan Government.

Fundamental Directions



*Scope 1: Direct greenhouse gas emissions from each institution (e.g., combustion of gases and fuels)
*Scope 2: Indirect emissions from the use of electricity, heat, and steam supplied by other companies
*Scope 3: Indirect emissions not included in Scopes 1 or 2 (e.g., indirect emissions related to research, education, and business activities)

Eco-Activity Promotion Policy

Humanity is facing unprecedented and severe global environmental crises, including global warming, resource and energy issues, and water resource problems. In particular, large cities, such as Tokyo, are not only the driving force behind the development of civilization but also major sources of greenhouse gas emissions due to the large-scale consumption of resources and energy, thereby having a significant impact on the Earth's environmental burden.
The Tokyo Metropolitan Public University Corporation, in line with its founding principles, strives to reduce environmental impact through educational and research activities for the sustainable development of large cities, and actively contributes to the future of the global environment and scientific and technological advancements.
With this in mind, a basic policy is established to promote eco-activities within the Corporation, and to collaborate and cooperate with citizens, businesses, the national government, Tokyo Metropolitan Government, and local municipalities. The goal is to achieve a sustainable society that overcomes environmental crises, including climate change.
When implementing specific measures based on this basic policy, efforts will take into account the maintenance and enhancement of the educational and research environment within the Corporation, as well as the characteristics of each educational institution, including Tokyo Metropolitan University, the Advanced Institute of Industrial Technology, and the Tokyo Metropolitan College of Industrial Technology.

Basic Policy

1. Promotion of academic research

Utilize the resources entrusted by the citizens of Tokyo and society in the most effective way to address environmental issues, promote research related to the environment, and broadly return the results to society.

2. Promotion of human resource development and student activities

Implement environmental education, foster individuals with a high awareness of various environmental issues, and aim to develop human resources who can actively contribute to society at large.

3. Energy management

Reduce the environmental burden arising from educational and research activities, and contribute to the construction of a low-carbon society and the prevention of global warming. This includes efforts to utilize renewable energy, promote resource and energy conservation measures, and optimize the disposal of waste and pollutants. At the same time, comply with environmental laws and regulations, and build an autonomous and sustainable environmental management system through cooperation among students, faculty, and staff. Strive to ensure proper operation of the system and actively publicize its results.

Promotion System

Eco-Activity Promotion Committee

- Promotion and review of the “Carbon Neutrality Promotion Plan”
- Progress management, including tracking initiatives
- Preparation of environmental reports

Committee Chairperson

Director of Administration of Tokyo Metropolitan Public University Corporation

Committee Members

Vice President of Tokyo Metropolitan University
OPI Director of the Advanced Institute of Industrial Technology
Vice Principal of the Tokyo Metropolitan College of Industrial Technology
Other members designated by the Chairperson from the working group
Senior Director of the Management &Planning Office, Tokyo Metropolitan Public University Corporation
Senior Director of the General Affairs Department, Tokyo Metropolitan Public University Corporation
Senior Director of the Administrative Affairs Department of TMU
Senior Director of the Administrative Affairs Department of AIIT
Senior Director of the Administrative Affairs Department of TMCIT

- Research Promotion Working Group
- Human Resource Development and Student Activities Working Group
- Energy Management Working Group

- Consideration and implementation of specific measures

- Tokyo Metropolitan University Subcommittee
- Advanced Institute of Industrial Technology Subcommittee
- Tokyo Metropolitan College of Industrial Technology Subcommittee

Roadmap of Initiatives

*Given the uncertainty regarding future electricity supply and other factors at the time of the formulation of the Carbon Neutrality Promotion Plan, a review will be conducted in 2025, five years before 2030.

		2023	2024	2025	2026	2027	2028	2029	2030	～
Energy management (greenhouse gas reduction)	Energy conservation activities campaign	Further promotion of energy conservation activities at each campus								
		Fostering energy conservation awareness among students, faculty, and staff								
	Renovation of energy conservation equipment	Planned updates to energy conservation equipment								
	Introduction of private power generation equipment	Imple-		Additional implementation (based on the status of external procurement of renewable energy)						
	External procurement of renewable energy (e.g., off-site PPA)	Method examination		Prompt implementation upon securing procurement						
	Utilization of new technologies	Cooperation in demonstration experiments for new technologies, and exploration and implementation of other energy-saving and energy-generating methods								
	Carbon offset							Review	Implementation	
Promotion of human resource development and student activities		Provision of learning environments								
		Support for environmental activities								
		Raising awareness of climate change and the climate crisis								
Promotion of academic research		Promotion of research in the faculties, graduate schools, and departments of the two universities and one technical college								
		Cooperation with the Tokyo Metropolitan Government								

Target for Reducing Greenhouse Gas Emissions from

Target *Scope 1 and Scope 2

- Aim to achieve carbon neutrality by the 2030s
- Achieve a reduction of at least 50% by 2030 compared to FY2013

*For Scope 3, actively work on appropriate calculation of emissions and exploring countermeasures.
*Given the uncertainty regarding future electricity supply and other factors at the time of the formulation of the Carbon Neutrality Promotion Plan, a review will be conducted in 2025, five years before 2030.

Approach to Achieving the Target

Direction (1): Reduce energy consumption

- Thoroughly reduce inefficient energy consumption
- Update energy-saving equipment, such as LED lighting

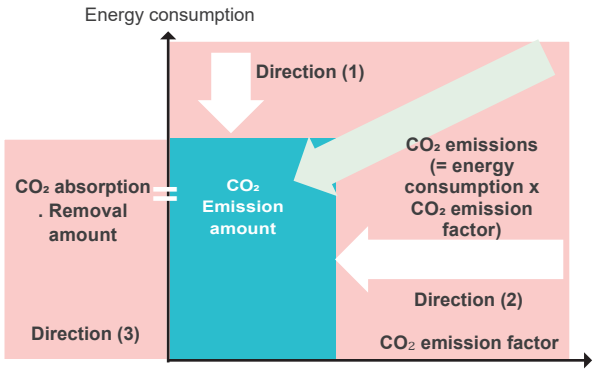
Direction (2): Expand use of low-carbon energy

- Introduce private power generation equipment (solar power generation)
- Examine and implement renewable energy procurement methods, such as off-site PPA

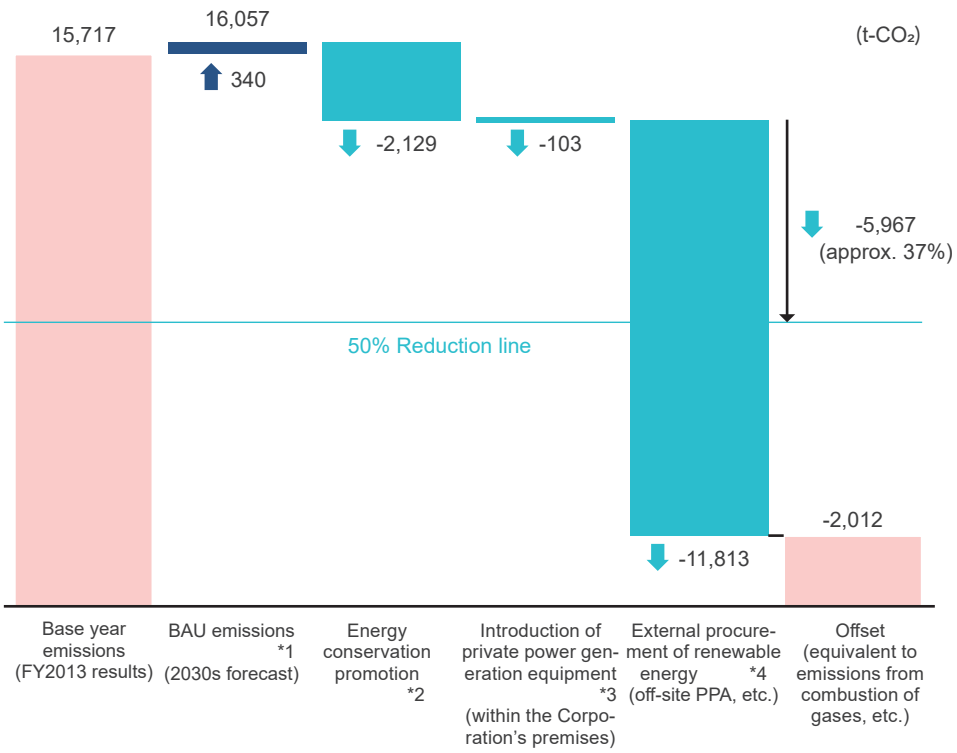
Direction (3): Expand CO2 absorption and removal

- Green conservation
- Examine carbon offsetting

(Conceptual diagram)



Breakdown of Reduction Methods for Achieving the Target



***1 BAU emissions**

BAU (Business As Usual) emissions refer to an estimate of the emissions that would occur if no specific measures were taken, reflecting a natural state. In this case of the Corporation, emissions are expected to increase following the construction of a new building at the Tokyo Metropolitan University Hino Campus.

***2 Energy conservation promotion**

Reduction achieved through measures such as equipment updates, proper management of room temperature and lighting, and operational reviews, including awareness-raising activities.

***3 Introduction of private power generation equipment**

Reduction achieved by generating renewable energy, such as installing solar panels on the Corporation-owned land and buildings.

***4 External procurement of renewable energy**

Reduction achieved by switching to off-site PPA or renewable energy plans offered by electricity providers, leading to non-fossil fuel-based procurement of electricity.

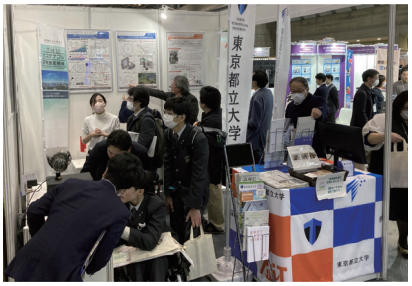
Main Activities and Initiatives to Achieve Carbon Neutrality in FY2023

Survey on Research Activities

In order to disseminate research related to carbon neutrality to society through proactive publicity, we conducted a survey for faculty members at two universities and one technical college in the summer and winter of 2023.

Exhibit at EcoPro 2023

We participated in the exhibition to proactively promote the activities and initiatives of the two universities and one technical college.



Creation of “Environmental Report 2023”

We created the 2023 edition of the report, which includes information on the Corporation’s environmental impact, such as CO_2 emissions and waste emissions for FY2022, as well as research activities at the two universities and one technical college.

Open University Courses

In the winter session, we held an online special course titled “What Should We Do to Shift Society Toward Sustainability in the Face of Climate Emergency?” as part of the “Thinking About Environmental Issues Now” special edition.

SDGs Training for Staff

We conducted e-learning for full-time staff, which included a speech by the chairperson on the latest climate change situation, as well as basic knowledge about SDGs, trends in society and business, and future prospects.

Visit to COP28

Five staff members visited the 28th Conference of the Parties (COP28) to the United Nations Framework Convention on Climate Change, held in December in Dubai, UAE. They attended lectures and workshops, visited exhibition booths on decarbonization hosted by government agencies, universities, and companies, and engaged in discussions with the Japan International Cooperation Center (JICE) local office, among others.

Construction of a Solar Carport and Renovation of Lighting Systems to LED at Each Campus

We signed a contract for the construction of a solar carport in the parking lot near the gymnasium at Tokyo Metropolitan University’s Minami-Osawa Campus. In FY2024, we plan to install solar panels with a capacity several times larger than the current solar power generation capacity at the campus. Additionally, we conducted detailed design work for the LED lighting system renovation at the Minami-Osawa Campus.

Cooperation with the Hino City Climate Citizens Conference

In collaboration with local municipalities, such as Hachioji City and Hino City, and in response to a proposal from Hino City, the chairperson gave a lecture at the Climate Citizens Conference operated by Hino City.

We promote energy management (Eco-Campus and Green Campus) in order to reduce our environmental impact and to actively contribute to the future of the global environment and the advancement of science and technology through education and research activities.

Promotion of Eco-Campus and Green Campus

Large cities, including Tokyo, significantly impact the global environment through the massive consumption of resources and energy, leading to high levels of greenhouse gas emissions.

Starting in April 2010, the Act on the Rational Use of Energy (hereinafter referred to as the “Energy Conservation Law”) and the Ordinance on the Environment to Ensure the Health and Safety of Tokyo Residents (hereinafter referred to as the “Tokyo Metropolitan Ordinance”) were amended, introducing new systems aimed at reducing environmental impact. The Energy Conservation Law mandates that the entire organization make efforts to reduce the annual energy consumption intensity by at least 1% on average per year.

In addition, the Tokyo Metropolitan Ordinance imposes an obligation on Tokyo Metropolitan University’s Minami-Osawa Campus to reduce its greenhouse gas emissions by 27% on a five-year average against the baseline emissions during the third plan period from FY2020 to FY2024.

Energy Conservation Targets and Obligations by Law

Specific Targets and Obligations

Energy Conservation Law

Reduce the annual energy consumption intensity by an average of at least 1% per year over five fiscal years (target)
(Applies to the entire corporation)

Ordinance on Environmental Preservation

Reduce greenhouse gas emissions by at least 27% on a five-year average from FY2020 to FY2024 (mandatory)
(Applies only to the Minami-Osawa Campus)

Major Initiatives

Proper management of room temperature and lighting

Air conditioning: 28°C

Heating: 20°C

Upgrading to high energy-efficiency equipment

Displaying energy conservation awareness posters

Promoting the 3Rs (reduce, reuse, recycle)

Ensuring thorough awareness and adherence to waste separation rules

Tokyo Metropolitan University has installed carbon offset vending machines at the Minami-Osawa and Hino campuses to reduce greenhouse gas emissions through carbon offset, in order to achieve carbon neutrality.

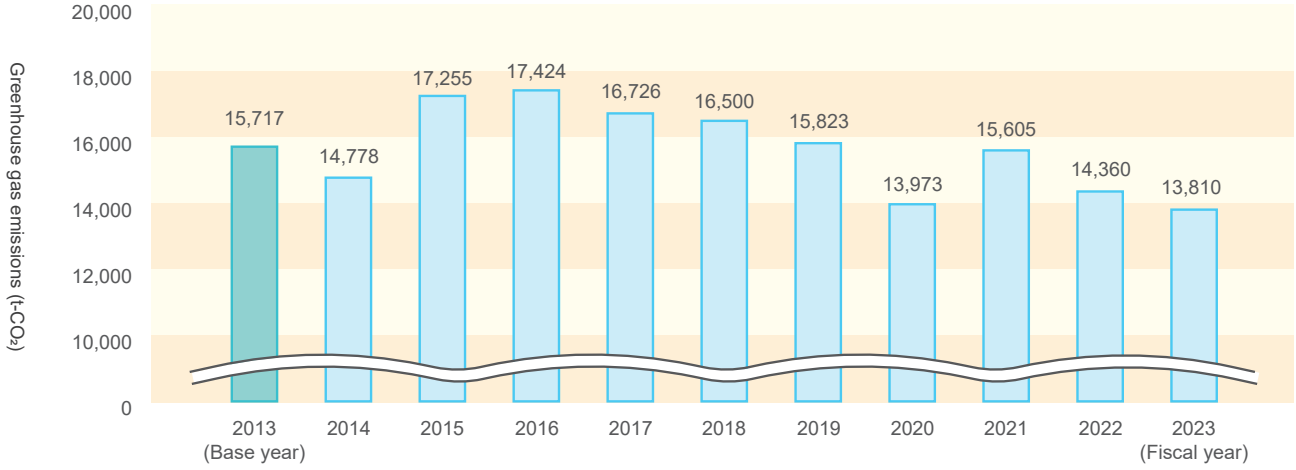
Carbon offset vending machine (Minami-Osawa Campus)

Garbage sorting (Hino Campus)

Promotion of Energy Conservation and Global Warming Countermeasures

Under the Energy Conservation Law and the Tokyo Metropolitan Ordinance, stringent targets, particularly for the Minami-Osawa Campus, have been set. As an organization, we must continuously meet these targets. Through the concerted efforts of students and faculty, we have consistently achieved a reduction in energy consumption per unit by more than 1% annually, earning an S-class rating. In addition, the Minami-Osawa Campus has successfully met its obligation to reduce greenhouse gas emissions.

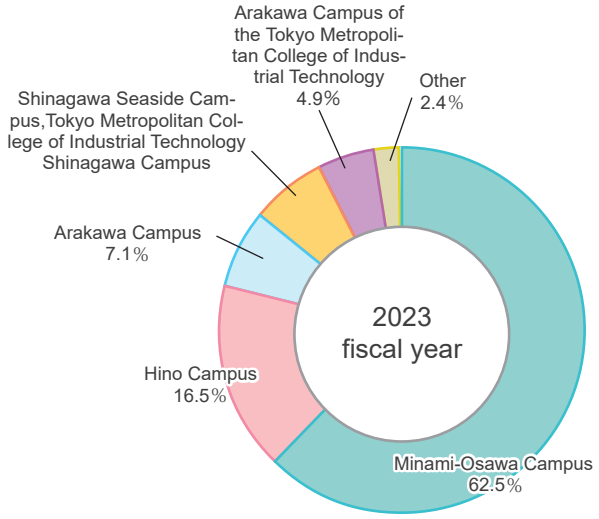
Greenhouse gas emissions



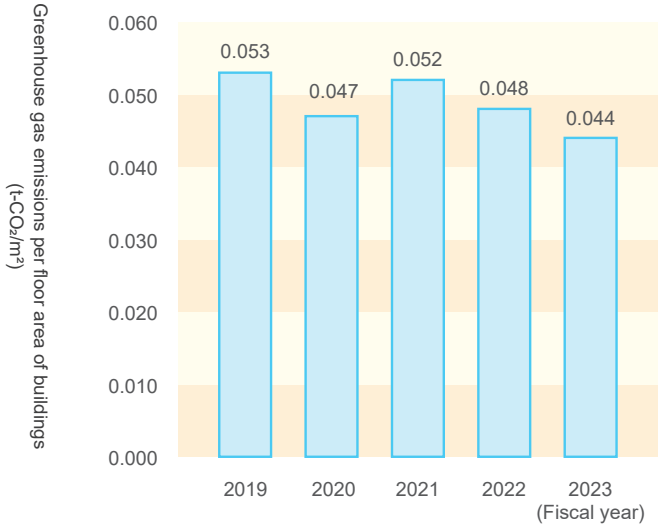
Greenhouse gas emissions have been trending downward since FY2016, with the exception of FY2020, which was particularly affected by the COVID-19 pandemic.

The calculation of greenhouse gas emissions is carried out in accordance with the GHG Protocol. Scopes 1 and 2 cover all campuses and offices of the Corporation. Scope 3 is calculated for the largest campus, Minami-Osawa, for FY2021 and FY2022 (Scope 3 is not included in the above graph). Going forward, we will explore the appropriate calculation and measures for Scope 3 emissions across the entire corporation.

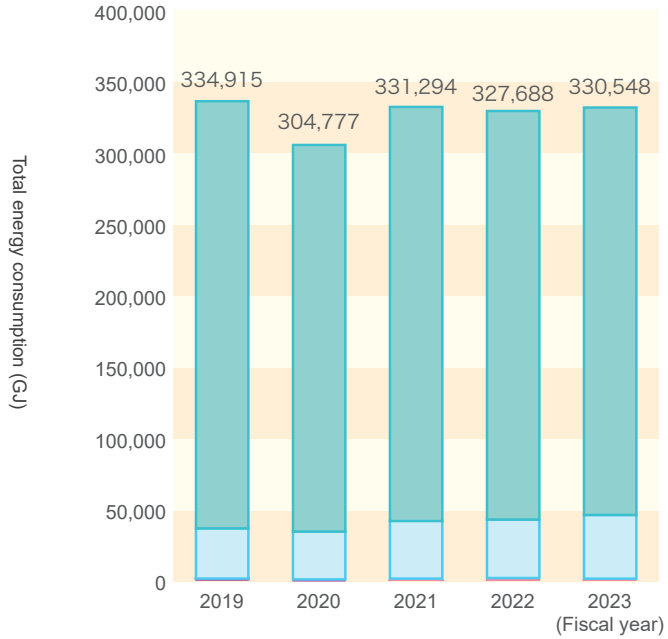
Percentage of greenhouse gas emissions by campus



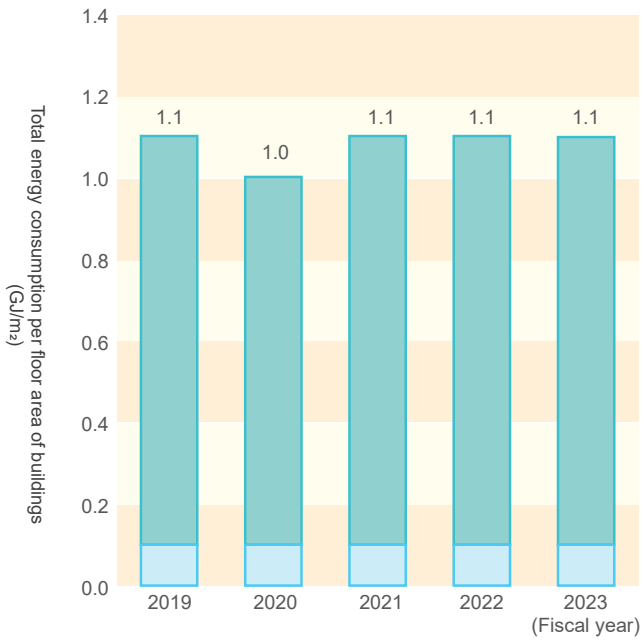
Greenhouse gas emissions per floor area of buildings



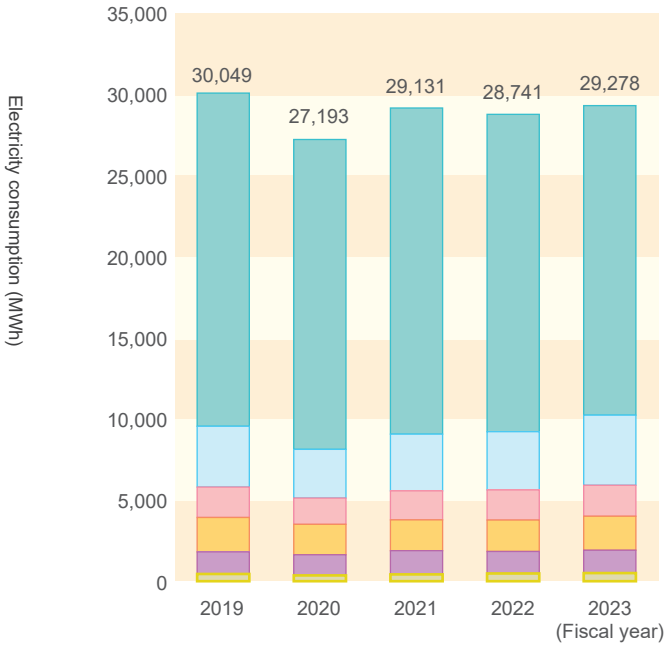
Total energy consumption



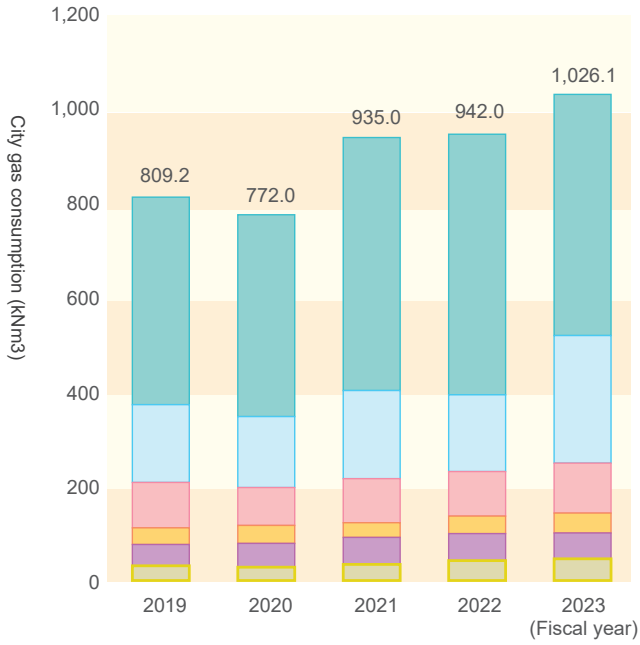
Total energy consumption per floor area of buildings

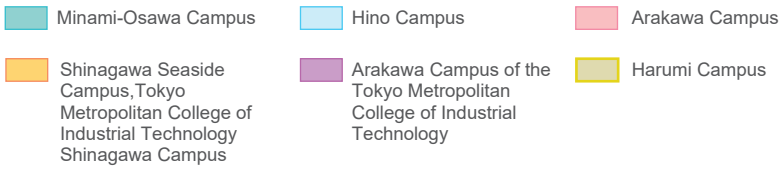


Electricity consumption



City gas consumption



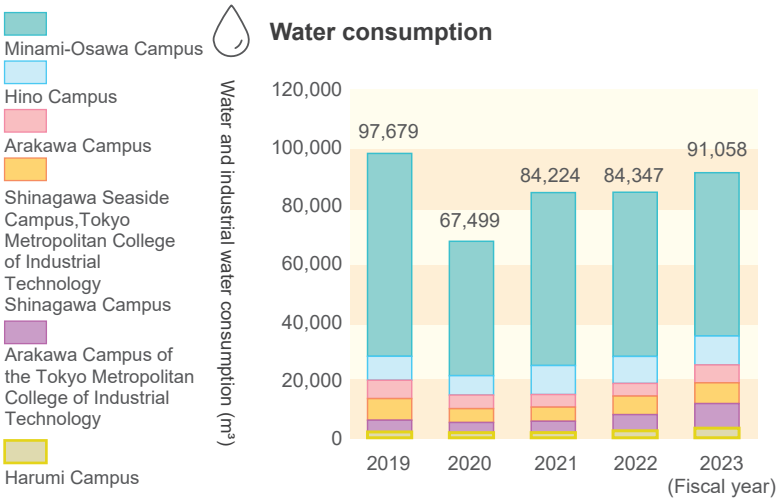


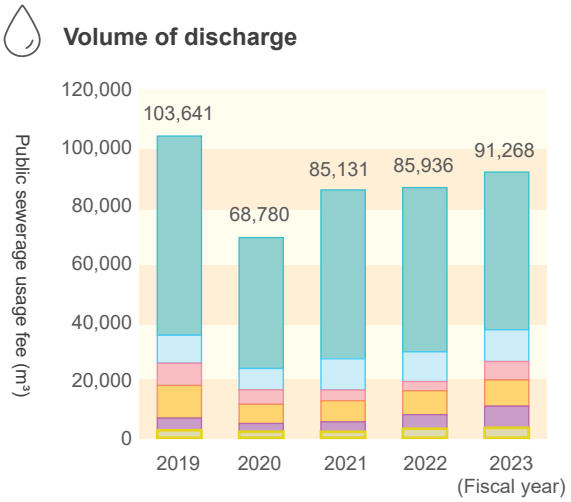
Promotion of Resource Conservation

The Corporation promotes resource conservation by implementing countermeasures to reduce water consumption and

Reduction of Water Consumption

We are implementing water-saving countermeasures, such as upgrading to water-saving toilets.

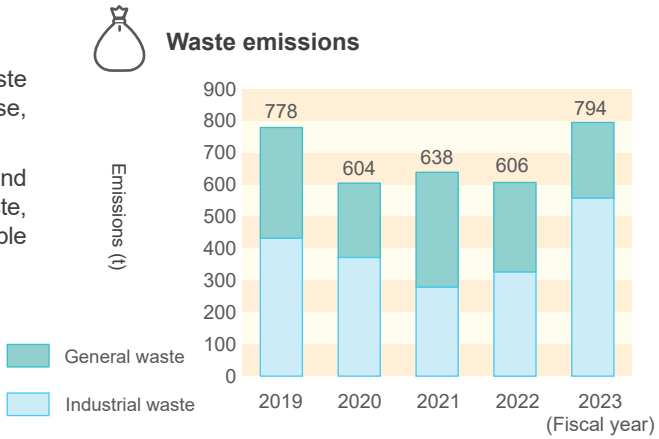




Proper Waste Management

The rules for waste sorting are posted at each facility and waste collection point on campus promoting the 3Rs (Reduce, Reuse, Recycle) and the proper sorting and disposal of waste.

Waste generated by the Corporation is properly managed and disposed of by sorting it into general waste (combustible waste, etc.) and industrial waste (plastic waste, sludge, non-combustible waste, scrap metal, etc.).



Material Balance

The environmental impact associated with education and research activities includes energy usage such as electricity, consumption of water resources, and emissions of greenhouse gases and waste. The environmental impact for FY2023 is as follows.

INPUT		
Energy	Electricity	29,278 MWh
	City gas	1,026 kNm³
	Kerosene	2 kL
	Heavy oil	1 kL
Water		91,058 m²

Tokyo Metropolitan Public University Corporation

OUTPUT	
Greenhouse gases	13,810 t-CO_2
Volume of discharge	91,268 m²
General waste	237 t
Industrial waste	557 t

Compliance with Environmental Laws and Regulations

The Corporation conducts research on environmental regulations and ensures compliance by implementing appropriate

Proper Management of Chemical Substances

The Corporation handles a large number of chemical substances in its educational and research activities. As the Corporation is subject to the PRTR (Pollutant Release and Transfer Register) Law, it investigates and aggregates the amounts of chemical substances handled that fall under Class I Designated Chemical Substances, as outlined in the law. For substances exceeding certain quantities, the Corporation reports their release into the environment as well as their transfer as waste. In FY2023, the two substances subject to PRTR reporting are listed in the table. The Corporation manages the purchase, usage, and storage of chemical substances and works to reduce the use of hazardous substances.

In addition, in compliance with the Tokyo Metropolitan Ordinance (Ordinance on Proper Management of Chemical Substances), the Corporation reports the usage of properly managed chemical substances for FY2023. The substances subject to this ordinance include nine types, such as acetone and chloroform.

Handling amounts of Class I Designated Chemical Substances under the PRTR Law in FY2023

Substance name	Emissions (kg/year)	Amount transferred
	Emissions to the atmosphere	Transfers outside the
Chloroform	330	1,100
N-hexane	170	930

Reported amounts of chemical substances under the Tokyo Metropolitan Ordinance in FY2023

Substance name	Amount used (kg/year)	Emissions to the atmosphere (kg/year)	Amount of waste (kg/year)
Acetone	2,000	380	1,600
Hydrochloric acid	700	0	700
Chloroform	1,400	330	1,100
Ethyl acetate	300	40	260
Dichloromethane	870	280	590
Toluene	130	20	110
Hexane	1,100	170	930
Methanol	1,200	250	950
Sulfuric acid	100	0	100

Proper Management of CFCs

In accordance with the Act on Rational Use and Proper Management of Fluorocarbons (Fluorocarbon Emission Control Law), the Corporation conducts regular inspections of commercial air conditioners, refrigeration, and freezer equipment subject to the law. Leakage amounts are properly managed, and there were no reportable leaks.

Fluorocarbons have been widely used for various purposes, such as refrigerants in air conditioners and refrigerators. However, their impact on the environment, including ozone layer depletion and global warming, has become evident, requiring thorough management.

In managing equipment covered by the Fluorocarbon Emission Control Law, we ensure awareness and strict adherence to the management methods specified by the law, as outlined in the table to the right.

Management methods for equipment subject to the Fluorocarbon Emission Control Law

- Installation in appropriate locations, etc.
- Equipment inspection
- Leakage prevention measures; in principle, prohibiting charging without repair
- Retention of inspection records, etc.

Tokyo Research Initiative for Sustainability(TRIS)

The Corporation established the “Tokyo Research Initiative for Sustainability(TRIS)” in January 2022 to strengthen its research capabilities in solving SDGs-related issues, including environmental problems.

TRIS promotes research aimed at solving municipal issues from an academic perspective, focusing on “sustainability,” and works to contribute research results to the metropolitan government. It also shares the outcomes through policy proposals to the Tokyo Metropolitan Government, publication on the website, and other channels.

Matching Government Needs and Research Seeds

TOKYO METROPOLITAN GOVERNMENT

Administrative issues for achieving a sustainable society

Presentation of issues
Request for research and study

Planning and proposal of research and study

Tokyo Research Initiative for Sustainability(TRIS)

Research and study on sustainability-related policy issues in the metropolitan area from an academic perspective

Collaborative research

Contracted projects

TRIS
Tokyo Research Initiative for Sustainability
TMUサステナブル研究推進機構
私たちは持続可能な開発目標（SDGs）を支援しています。

Research Fields and Examples of Initiatives

Environment	● Renewable energy and hydrogen energy ● CO_2 reduction and utilization ● Climate change prediction	Realization of a Zero-Emission Tokyo Hydrogen Society
Economy	● Sustainable finance ● Social big data ● Regional disparities	Realization of “Global Financial City : Tokyo”
Society	● Cultural diversity ● Poverty issues ● Measures for super-aging in large cities	Promoting Diversity & Inclusion
Technology	● Medical-engineering collaboration ● Advanced information and communication systems ● Artificial intelligence	Realization of “Smart Tokyo” and the “TOKYO Data Highway”

First among national and public universities

Declaration for a Nature Positive Society that Coexists in Harmony with Nature

In recent years, the increase in climate change and human activities has had a severe impact on ecosystems, leading to a loss of biodiversity. In this context, climate change measures and biodiversity initiatives are being discussed globally as interconnected issues, with the realization of “Nature Positive”*1 being a key goal.

In response to this situation, in July 2024, the Tokyo Metropolitan Public University Corporation issued a “Nature Positive Declaration.” This declaration reaffirms the recognition that the Earth’s ecosystems, which are facing a crisis, are essential for the realization of a sustainable society. The declaration also pledges to engage in the conservation, research, and educational activities related to these ecosystems.

In terms of biodiversity research, the university is advancing studies on plant diversity using a vast collection of plant specimens, including extinct plants, collected by Dr. MAKINO Tomitaro, housed at the Makino Herbarium at Tokyo Metropolitan University. Since the return of the Ogasawara Islands in 1968, the university has been conducting research on the ecosystems of the islands, being the only university in Japan with a research facility on the islands. The research greatly contributed to the registration of the Ogasawara Islands as a UNESCO World Natural Heritage site in 2011. The university is also involved in studies on the utilization of biodiversity information and the diverse relationships between people and nature.

In July 2021, the university issued a “Climate Emergency Declaration” and has been promoting various initiatives based on the Carbon Neutrality Promotion Plan. Going forward, the university will continue to advance its efforts, including those outlined in the Nature Positive Declaration, and contribute the research findings back to society.

The only university in Japan to issue a Climate Emergency Declaration and Nature Positive Declaration*2

Climate Emergency Declaration / Nature Positive Declaration poster

Nature Positive Declaration by the Tokyo Metropolitan Public University Corporation

Our central stance is that the global ecosystem, which is currently in a state of crisis, constitutes an international public asset vital to the establishment of sustainable societies. Reaffirming this position, the Tokyo Metropolitan Public University Corporation hereby presents this Nature Positive Declaration, alongside a declaration of its commitment to conservation, research, and educational activities on behalf of the global ecosystem.

We will further:

1. Promote academic research and management that contributes to nature positive, carbon neutral, and other goals and initiatives.
2. Establish an environment for students and the public that will encourage independent learning about nature positive, carbon neutral, and other environmental issues.

July 16, 2024

YAMAMOTO Ryoichi,Chairperson	Tokyo Metropolitan Public University Corporation
OHASHI Takaya,President	Tokyo Metropolitan University
HASHIMOTO Hiroshi,President	Advanced Institute of Industrial Technology
YOSHIZAWA Masasumi,President	Tokyo Metropolitan College of Industrial Technology

*1 Nature Positive (Nature Revitalization) means putting nature back on a recovery trajectory by halting and reversing the loss of biodiversity.
*2 As of November 2024.

Advancing Carbon Neutrality: Creating the Tokyo Metropolitan Public University Corporation Logo

In FY2023, the Tokyo Metropolitan Public University Corporation created a logo to promote initiatives such as carbon neutrality, based on feedback from faculty, staff, and students of the two universities and one technical college. While the individual schools had established symbol marks, there was no logo for the Corporation itself, and nothing available for widespread use across the two universities and one technical college.
The logo will be used as a tool to foster a sense of unity around activities contributing to carbon neutrality at these three schools, as well as to aid in further collaboration and enhance recognition of these efforts.

Concept

The logo is intended to represent the Corporation's commitment to promoting a wide range of activities that contribute to the SDGs, including the advancement of climate change countermeasures.

The logo design uses the Corporation's initial "T" as a representation of the Earth's outline. It incorporates motifs of "Global Climate Change," "Youth & Smiles," and "Improvement" to express growth toward a bright future, dreams, and hope. The design features a gentle gradient that evokes the image of the SDGs.

Tokyo Metropolitan
Public University Corporation

The logo is featured on staff business cards, eco-bags, and other promotional items, contributing to awareness-raising efforts. These awareness items have been distributed at events such as EcoPro 2023 and Hachioji Environmental Festival 2024. Moving forward, the logo will continue to be incorporated into various public relations materials to promote the Corporation's initiatives.

Promotional items featuring the logo

Designing a Digital Information Base for Tokyo's Biodiversity - Under Agreement with the Tokyo Metropolitan Government -

Tokyo is Japan's largest city with a population of 14 million. There are mountains and satoyama of the hilly areas of Okutama, green areas and waterfronts in the urban areas, and ecosystems unique to islands. Ascertaining the distribution of wildlife in Tokyo will significantly impact biodiversity conservation. In the context of increasing international attention toward nature-positive, the Tokyo Metropolitan Government launched the "Project to Create TOKYO Digital Wildlife Inventory with Residents of Tokyo" in 2023 to collect basic biodiversity-related information.

Verifying wildlife distribution across Tokyo will entail considerable time and effort. Therefore, the Project set up the "Tokyo living creatures investigation team" with the Tokyo Metropolitan Government, experts, and Tokyo residents to create a real-time and comprehensive "TOKYO's wildlife inventory." The team will collect and store information regarding Tokyo's wildlife based on citizen science, employing "Biome"—a living organisms collection smartphone app designed for biodiversity observation and species identification,Biome and "BiomeSurvey"—a biological surveys application.

This article discusses the efforts of Assistant Professor Hidetoshi Kato of the Department of Biological Sciences, School of Science, Tokyo Metropolitan University, who participates in the Project as an expert.

Tokyo wildlife inventory creation flow

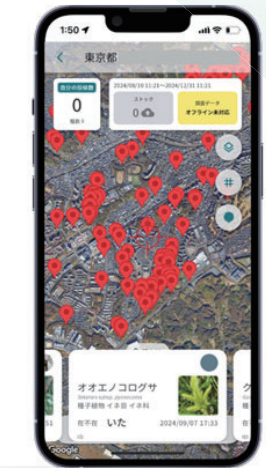
Role of the Tokyo Metropolitan University

In 2024, the Tokyo Metropolitan University signed an agreement with Tokyo Metropolitan Government, the Bureau of Environment to serve as the Secretariat for Creating Tokyo Digital Wildlife Inventory and Flora Inventory. The relevant office is located in the University's Makino Herbarium. The Secretariat performs wide-ranging tasks: gathering information and conducting field surveys on plant diversity in Tokyo; creating public awareness and promoting surveys; developing applications for gathering information; and investigating, accepting, and digitizing plant specimens and literature owned by individuals and organizations.

The Secretariat emphasizes and promotes surveys in collaboration with plant lovers and "citizen scientists"—these are amateur researchers—familiar with Tokyo's landscape, positioning them as the "expert survey team." For instance, when the team conducts surveys to collects plant specimens in national and metropolitan parks in Tokyo, the Secretariat secures permits and negotiates with landowners, if required. In places where physical specimen collection is difficult, the Secretariat employs the "BiomeSurvey" wherein the team takes photos with location information. Furthermore, the Secretariat gathers information using the functions within the "Biome" app to facilitate the participation of Tokyo residents in the "citizen survey team."

Necessity of photographs and specimens

"Biome" and "BiomeSurvey" can capture the date and location information of plant ecology photographs taken using the apps. This facilitates gathering wide-area multi-point plant-distribution information in collaboration with citizens. However, accurate identification of plants requires detailed observation of parts (often under a magnifying glass and/or microscope) and size measurement, and, therefore, ecology photographs are inadequate. Thus, real plant specimens and information obtained using "Biome" and "BiomeSurvey" will help create an inventory with accurate and real-time distribution information regarding Tokyo's wildlife.



BiomeSurvey on smartphone screen Displaying location information and photo on map

Plant specimen

Why now? Purpose and significance of creating wildlife inventory

To date, "Tokyo" had not released any wildlife inventory based on concrete evidence such as specimens. This is because Tokyo does not have its own natural history museum (or a museum that includes natural history). Thus, there exist few experts (curators) to continually conduct surveys and research regarding Tokyo's natural environment and biodiversity, and to centrally accumulate and manage natural history specimens and related materials gathered in Tokyo.

A wildlife inventory constitutes the most basic source of information for conserving Tokyo's natural environment and biodiversity. For example, in the process of developing and revising Tokyo's Red List of extinct and endangered species and the Red Data Book that provides information on all species, the lack of a comprehensive inventory will hinder ascertaining the species that are "important for protection." Furthermore, real-time information regarding biological distribution will clarify how the natural environment and biota have changed in Tokyo. This information will be useful in determining priorities and targets for protection.

The Project's development of information infrastructure on natural environment and biodiversity is assumed to lead to Nature Positive.

What experts intend to convey to Tokyo residents

Residents and communities engaged in nature observation and conservation activities in Tokyo possess substantial information regarding the wildlife of their areas, such as specimens, literature, and other materials. However, this information is vulnerable to dissipation. In addition to supporting their activities, we intend to build a system to appropriately store and organize the information and materials for utilization in academic and conservation endeavors. The "wildlife inventory" created by the Project will be a kind of "treasure map." We hope it will render Tokyo's current and future residents more sensitive toward their environment.

Assistant Professor **KATO Hidetoshi**

Department of Biological Sciences, School of Science, Tokyo Metropolitan University

Assistant Professor Kato conducts research on the following themes: surveys on the origin, species differentiation, and ecology of plants of Ogasawara Islands; Metropolitan Tokyo's vascular flora surveys; database construction of plant specimens, etc. Additionally, he engages in the collection and organization of plant specimens at the Makino Herbarium.

Tokyo Metropolitan University

頁	掲載内容	教員名等
23-24	Production of Useful Substances from Atmospheric Carbon Dioxide and Nitrogen Gas Utilizing Cyanobacteria	Professor EHIRA Shigeki Department of Biological Sciences, Graduate School of Science
25-26	Prediction of Changes in Asian Summer Monsoon Rainfall	Assistant Professor TAKAHASHI Hiroshi Department of Geography,Graduate School of Urban Environmental Sciences
27-28	High Performance and High Reliability of Power Electronics Circuits	Professor WADA Keiji Department of Electronic Information Systems Engineering, Graduate School of Systems Design
29	“T-MIT Birdman Club” Receives The Japan International Birdman Rally 2023 Environmental Award!	T-MIT Birdman Club
30	Webinar Held with the University of Malaya: Sharing Sustainable Initiatives	—

Advanced Institute of Industrial Technology

頁	掲載内容	教員名
33	Future Mobility and Infrastructure Design as Systems	Professor TAKASHIMA Shinji Graduate School of Industrial Technology

Tokyo Metropolitan College of Industrial Technology

頁	掲載内容	教員名・キャンパス名
36	Electricity Supply and Demand Adjustment System toward Massive Growth of Solar Power Generation — Fostering Awareness in the Classroom —	Associate Professor KAWASAKI Norihiro lectrical and Electronics Engineering Program Monozukuri Department
37	Future Workshop Project: “Temperature Changes in Indoor Spaces Due to Heat Shielding”	Shinagawa Campus
38	Behavioral Changes Through the Installation of Water Dispensers	Arakawa Campus

TOKYO METROPOLITAN UNIVERSITY
東京都立大学

Overview

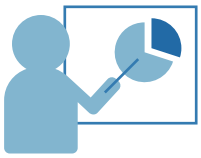
●Name	Tokyo Metropolitan University
●Date of Establishment	April 2005
●President	OHASHI Takaya

Number of students, faculty, and staff

(As of May 1, 2024)

*The student numbers include those enrolled in the organization prior to FY2017 (before the reorganization). Faculty and staff numbers include temporary staff and encompass the entire Corporation (such as the Corporate Planning Office and General Affairs Department).

Number of students
9,147



Number of faculty
652

Number of staff
558

Number of students

[Undergraduate Programs]

Faculties	Current enrollment (persons)
Faculty of Humanities and Social Sciences	914(558)
Faculty of Law	900(410)
Faculty of Economics and Business Administration	857(334)
Faculty of Science	846(251)
Faculty of Urban Environmental Sciences	1,121(385)
Faculty of Systems Design	1,413(278)
Faculty of Health Sciences	815(669)
Students prior to FY2017 (prior to restructuring)	10(5)
Total	6,876(2,890)

*Figures in parentheses indicate the number of female students.

[Advanced Programs]

Advanced courses	Current enrollment (persons)
Midwifery	10(10)

*Figures in parentheses indicate the number of female students.

[Graduate Programs]

Graduate schools	Total master's program enrollment (persons)	Total doctoral program enrollment (persons)	Total professional degree program enrollment (persons)
Graduate School of Humanities	100(60)	100(60)	-
Graduate School of Law and Politics	14(4)	13(4)	101(34)
Graduate School of Management	108(15)	36(8)	-
Graduate School of Science	305(95)	90(27)	-
Graduate School of Urban Environmental Sciences	358(119)	100(32)	-
Graduate School of Systems Design	540(96)	113(22)	-
Graduate School of Human Health Sciences	152(80)	106(38)	-
Students prior to FY2017 (prior to restructuring)	-	25(9)	-
Total	1,577(469)	583(200)	101(34)

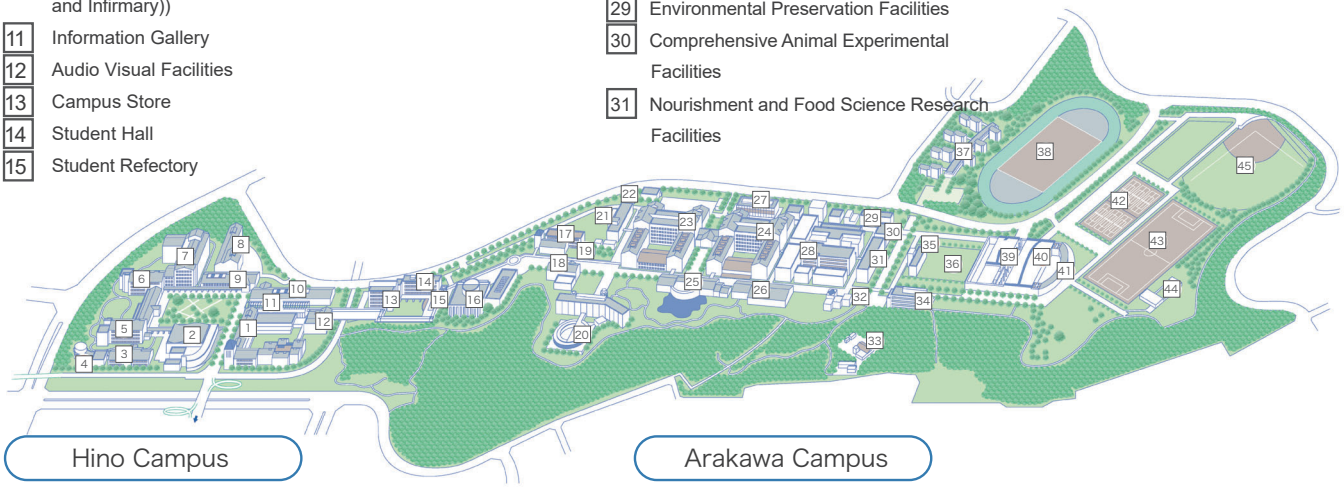
*Figures in parentheses indicate the number of female students.

Campus Map

Minami-Osawa Campus

■ Faculty of Humanities and Social Sciences ■ Faculty of Law ■ Faculty of Economics and Business Administration ■ Faculty of Science ■ Faculty of Urban Environmental Sciences ■ Faculty of Systems Design (mainly 1st and 2nd year) ■ Faculty of Health Sciences (1st year) ■ Graduate School of Humanities ■ Graduate School of Law and Politics ■ Graduate School of Management ■ Graduate School of Science ■ Graduate School of Urban Environmental Sciences ■ Graduate School of Human Health Sciences (Health Promotion Science) ■ Tokyo Metropolitan University Premium College

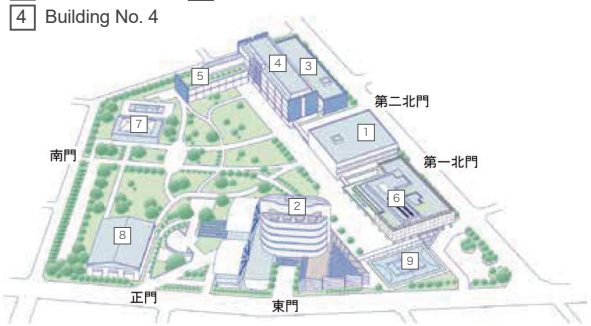
1 Building No. 1 Classrooms Tokyo Metropolitan University Administration (Educational Affairs and Student Affairs)
2 Auditorium
3 Building No. 2 Urban Policy, Faculty of Urban Environmental Sciences, TMU Premium College Office
4 The 1991 Hall Curator's Course Exhibition Room
5 Building No. 3 Faculty of Economics and Business Administration
6 Building No. 4 Faculty of Law
7 Building No. 5 Faculty of Humanities and Social Sciences
8 Building No. 6 Head Office General Education Center, Tokyo Metropolitan University Administration Department (Admissions Center (Entrance Examination Section))
9 Building No. 7 Tokyo Metropolitan University Administration (Career Development, Health Support Center (Student Counseling and Infirmary))
10 Information Gallery
11 Audio Visual Facilities
12 Campus Store
13 Student Hall
14 Student Refectory
15 Diversity Promotion Office, Central Library
16 Computer Center
17 The Makino Herbarium
18 The Makino Herbarium Annex TMU Gallery
19 International House
20 Radioisotope Research Center
21 Animal Facilities
22 Building No. 8, Faculty of Science / Faculty of Urban Environmental Sciences
23 Building No. 9, Faculty of Science / Faculty of Urban Environmental Sciences
24 Building No. 11, Classrooms
25 Building No. 12, Classrooms
26 Frontier Research Building
27 Building No. 10, Experimental Facilities
28 Environmental Preservation Facilities
29 Comprehensive Animal Experimental Facilities
30 Nourishment and Food Science Research Facilities
31 Cafeteria
32 Greenhouse & Experimental Garden
33 Building No. 13
34 Project Research Building
35 Multi-Purpose Sports Field
36 Dormitories
37 Athletic Field
38 Indoor Swimming Pool
39 Gymnasium
40 Club Rooms
41 Tennis Courts
42 Soccer Ground
43 Japanese & Western Archery Range
44 Baseball Field
45



Hino Campus

■ Faculty of Systems Design (mainly 3rd and 4th year)
■ Graduate School of Systems Design

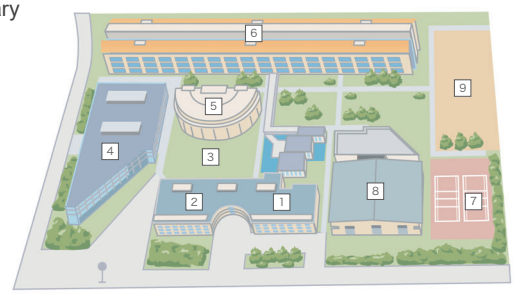
1 Building No. 1
2 Building No. 2
3 Building No. 3
4 Building No. 4
5 Building No. 5
6 Building No. 6
7 University Hall
8 Gymnasium
9 Futsal/Tennis Court



Arakawa Campus

■ Faculty of Health Sciences (2nd-4th years) ■ Department of Midwifery
■ Graduate School of Human Health Sciences (excluding Health Promotion Sciences)

1 Health & Welfare Wing
2 Administration Wing
3 Courtyard
4 Library
5 Auditorium
6 Lecture Rooms
7 Tennis Courts
8 Gymnasium
9 Ground



都立大荒川キャンパス前

Minami-Osawa Campus
1-1 Minami-Osawa, Hachioji-shi, Tokyo 192-0397
Land area: 428,041.26 m2 Total floor area: 166,916.32 m²

Hino Campus
6-6 Asahigaoka, Hino-shi, Tokyo 191-0065
Land area: 62,439.61 m2 Total floor area: 43,767.96 m²

Arakawa Campus
7-2-10 Higashiogu, Arakawa-ku, Tokyo 116-8551
Land area: 34,999.97 m2 Total floor area: 29,635.27 m²

Harumi Campus (jointly built with Tokyo Metropolitan Harumi Comprehensive High School)
1-2-2 Harumi, Chuo-ku, Tokyo 104-0053
Land area: 1,687.30 m2 Total floor area: 9,869.02 m²

Iidabashi Campus
Tokyo Kuseikan 3F, 3-5-1 Iidabashi, Chiyoda-ku, Tokyo 102-0072
Total floor area: 873.83 m²

Marunouchi Satellite Campus
Marunouchi Eiraku Building 18F, 1-4-1 Marunouchi, Chiyoda-ku, Tokyo 100-0005
Total floor space: 1,394.64 m²

Ogasawara Research Facility
1-3 Miyanohamamichi, Chichijima, Ogasawara-mura, Tokyo 100-2101
Land area: 771.45 m2 Total floor area: 546.73 m²

President, Tokyo Metropolitan University
OHASHI Takaya

The planet Earth is probably the only habitable planet in the universe that is within the reach of humanity for the foreseeable future and is irreplaceable both for humanity and for academic purposes. The Earth, in which life has evolved throughout its 4.5 billion year history, is the parent of all forms of life, including humans, and it is our mission to protect this beautiful planet.

However, recent climate change and the frequent occurrence of natural disasters, believed to be caused by climate change, indicate that the global environment is changing to a serious degree as a result of human activities. What should we do now to protect the earth and preserve life? Universities should take the initiative to bring together people's knowledge and undertake this challenge.

In July 2021, the Tokyo Metropolitan Public University Corporation issued a declaration of climate emergency and formulated the “Carbon Neutrality Promotion Plan” in FY2022 to put into action efforts toward carbon neutrality. The plan calls for a 50% reduction in greenhouse gas emissions (Scope 1 and 2) by 2030 compared to fiscal 2013, with the goal of achieving carbon neutrality in the 2030s, and efforts have begun to implement this plan. In the area of research, the TMU Sustainable Research Promotion Organization, established by the corporation, is conducting research on 8 themes, aiming to contribute to solving social issues from the perspective of sustainability.

In the Environmental Report of TMU, we introduce research that will lead to the realization of carbon neutrality and to solutions to abnormal weather, such as research on cyanobacteria that produce useful substances from carbon dioxide and nitrogen in the atmosphere, research on precipitation from the Asian summer monsoon that will lead to understanding of abnormal weather, research on power electronics that will support future electricity supply, and research on the use of The University will also introduce its research on cyanobacteria, which produces useful substances from atmospheric carbon dioxide and nitrogen, and its winning of the 2023 Environmental Prize in the Bird Contest and a joint webinar conducted with the University of Malaya on sustainability. We hope you will understand that TMU is engaged in various activities that lead to the improvement of the global environment.

This is the third environmental report compiled by the corporation and Tokyo Metropolitan University. We will continue to actively promote various initiatives as a university and actively communicate them. We appreciate your guidance and support.

Production of Useful Substances from Atmospheric Carbon Dioxide and Nitrogen Gas Utilizing Cyanobacteria

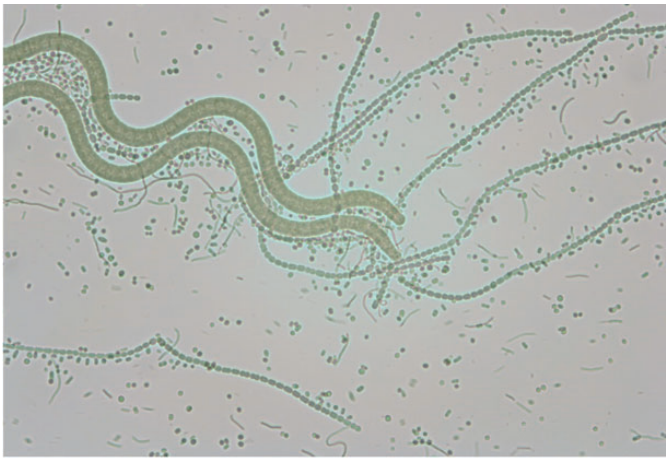
Professor **EHIRA Shigeki**
Department of Biological Sciences, Graduate School of Science

I specialize in microbial molecular physiology. Here, I aim to explain the environmental adaptation mechanism of cyanobacteria and their structure of environmental response and accompanying control of cellular differentiation at the molecular level.

Although cyanobacteria are photosynthetic bacteria, I introduce the production of useful substances from atmospheric carbon dioxide (CO_2)- and nitrogen (N_2)-utilizing cyanobacteria.

Cyanobacteria expected to play an active role in the fields of food, medicine, and biotechnology

Cyanobacteria are photosynthetic bacteria with cell sizes of 2–3 micrometer (μm) in diameter and are thus not visible to the naked eye. They are commonly found in lakes, ponds, and oceans, and any well-lit areas with small amounts of water, including puddles found in deserts, hot springs, and glaciers. Cyanobacteria are estimated to have originated approximately 2.5 billion years ago, and thousands of species are currently known. Some species have been used as food since early times and are commonly used as health food and food dye. As they can be cultured in great quantities with only a limited amount of inorganic salt and light, they are being researched and developed as food for space travel. Furthermore, production technology is being developed to utilize CO_2 generated by cyanobacteria photosynthesis through solar energy as a source for medicine, plastics, and biofuel. Extensive attempts have been made to utilize cyanobacteria in the fields of food, medicine, and science (biotechnology).



Cyanobacteria

Thousands of species of cyanobacteria that differ in cell size, form, and physiological characteristics currently inhabit Earth. The image above shows four species of cyanobacteria.

Further possibilities of cyanobacteria

Most cyanobacteria absorb CO_2 through photosynthesis and are capable of fixing nitrogen by absorbing N_2 from the atmosphere. Therefore, cyanobacteria synthesize organic compounds from CO_2 and N_2 in the atmosphere using light energy. Nearly 80% of Earth's atmosphere consists of N_2; however, organisms that can directly utilize N_2 are limited to a very small percentage of prokaryotes. All other organisms are unable to utilize N_2. Notably, chemical compounds containing nitrogen such as fertilizers, drugs, and chemical products are essential to our daily life. The synthesis of these nitrogen compounds, which are made from ammonia, currently consumes a significant amount of energy and fossil fuel. Previous research on the production of substances using photosynthetic organisms such as cyanobacteria aimed to advance sustainable production by using atmospheric CO_2 as a basic material. When using cyanobacteria, CO_2 as well as N2 from the atmosphere can be used to produce substances, thereby enabling a more environmentally friendly production system.

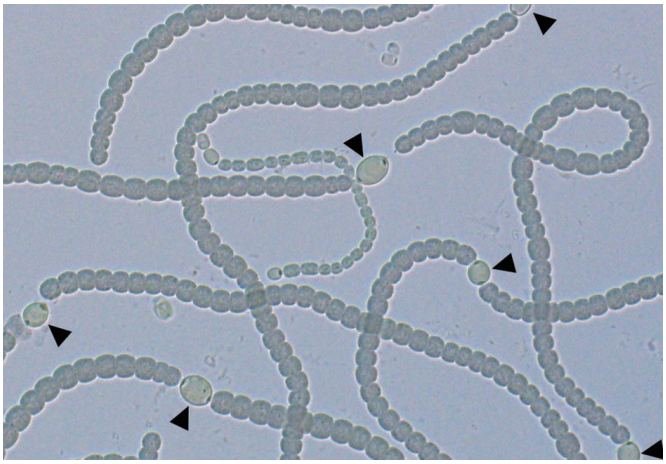
Production of substances from CO_2 and N_2

The two processes of photosynthesis and nitrogen fixation are incompatible. Photosynthesis produces oxygen as a by-product; however, nitrogen fixation requires an environment without oxygen. This is because nitrogenase, the enzyme responsible for nitrogen fixation, is highly susceptible to destruction by oxygen. Therefore, it is difficult for photosynthesis and nitrogen fixation to occur within the same cell.

To address this oxygen problem, the two processes have to be separated by time or space. When separated by time, photosynthesis is conducted during daytime and nitrogen fixation during nighttime using the glucose produced by photosynthesis during the day. When separated by space, cyanobacterial cells specialized for nitrogen fixation are prepared.

Some cyanobacteria grow in long chains and form a filamentous structure. These are termed nostoc (nenjemo in Japanese) cyanobacteria. When observed using a microscope, some cells visibly differ in shape. These are the cells that conduct nitrogen fixation and are referred to as heterocysts. Because heterocysts do not perform photosynthesis, their environment without oxygen is suitable for nitrogen fixation. However, without photosynthesis, they cannot generate the energy required for nitrogen fixation. Therefore, they receive glucose produced through photosynthesis from adjacent cells and provide these cells with nitrogen compounds produced through nitrogen fixation.

In my research career, I study how nostoc cyanobacteria produce heterocysts and how matter and information are exchanged between photosynthetic cells and heterocysts. I am currently studying the utilization of cyanobacteria in producing useful substances from atmospheric CO_2 and N2 with light as an energy source. As with the present-day promotion of sustainable fashion, I conduct research on the use of cyanobacteria to make raw materials for nylon. Nylon is a chemical fiber derived from petroleum, produced by polymerizing dicarboxylic acids and diamines in a specific order. Diamine is composed of nitrogen, hydrogen, and carbon, and is a substance produced by organisms within their cells. Through genetic modification, we have been able to produce cyanobacteria capable of making diamine; however, the amount of diamine produced is currently small and the process is timely. Significant improvement is required to enable the development of a usable product. For more efficient production of diamine, cyanobacteria should be genetically modified to ensure a smoother conversion of CO_2 and N_2 into the desired target product. However, we are unable to fully predict which modification of genes brings about certain changes. Therefore, numerous hypotheses should be investigated to gather information and better understand the processes that occur within the organism. Our objective is to deepen our understanding and design the structure of the organism based on desired characteristics.



Microscopic picture of nostoc

Among the filaments of photosynthetic cells, nitrogen-fixing heterocysts (shown with black arrows) can be observed.

Connecting basic research to the future

I conduct basic research, which I believe leads practical application by enhancing our basic knowledge. I hope to collect research results that can be applied in industrial production. I also hope that my research may ignite the interest of others in biological science. I was not interested in biology from the start of my studies and career, but had wondered why living things are alive and why I am able to live. The mystery of genomes and genes of organisms led me to biology. I hope that more people will acquire an interest in what organisms can do and why they can do it.

Prediction of Changes in Asian Summer Monsoon Rainfall

Assistant Professor **TAKAHASHI Hiroshi**
Department of Geography,Graduate School of Urban Environmental Sciences

As an assistant professor at the Graduate School of Urban Environmental Sciences, I study meteorology and climatology. I study water circulations on the regional and global scales and climate change, focusing on precipitation and clouds in the Asian monsoon region. Also, I investigate the changes in rainfall characteristics due to land surface conditions and the influence of land surface modification on regional climate, using Earth observation satellites, climate simulations, and artificial intelligence.

Here, I discuss predicted rainfall changes in the Asian summer monsoon region with the aim of gaining a scientific understanding of climate change in Asia, including in Japan.

Impact of climate change and weather anomalies

In recent years, it has been reported that the Earth's surface air temperature is rising because of climate change in various parts of the world; particularly in summer, this rise in surface air temperature has had a significant negative impact on human health and living, as evidenced by the increased risk of heatstroke and power shortage.

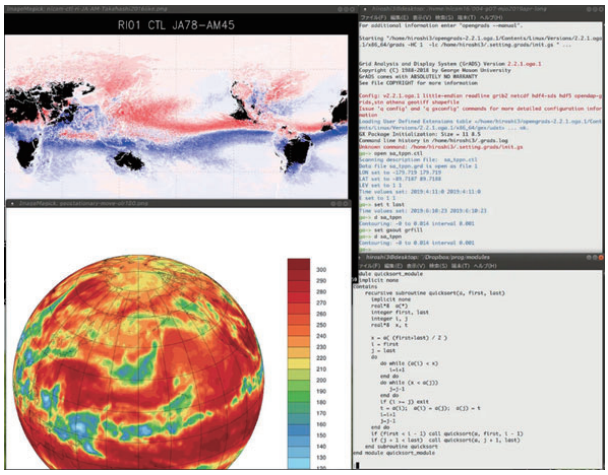
We identified via long-term satellite observations that rainfall activity of the seasonal rain front (Baiu), which often causes natural disasters in Japan and other East Asian countries, has been dramatically active in the last 10 years. This can also explain the occurrence of the 2020 Kyushu floods (Heavy rain in July, Reiwa 2), which caused severe damage in the Kyushu region in 2020.

In the future, the number of extreme weather events on a global scale caused by climate change is likely to increase, and they may have an even greater impact on humans and global environment. Therefore, it is necessary to adjust to climate changes and implement disaster prevention measures in accordance with the changing climate. If we can successfully reproduce the actual meteorological and climatic phenomena in our meteorological and climatic simulation studies, we may be able gain better insights into the meteorological and climatic mechanisms underlying them; these insights can be used in improving weather forecasts and taking disaster prevention measures against hazards such as large typhoons and heavy rains.

Focusing on future change in precipitation in the Asian monsoon region

Future projecting of summer precipitation is critical in the Asian monsoon region, where the global population is highly concentrated. The behavior of the Asian monsoon is closely associated with Japan's climate. For example, the 2020 Kyushu floods mentioned above, the 2018 West Japan floods, and the ongoing extreme heatwaves are related to variations in Asian monsoon precipitation. Asian monsoon circulation in the lower troposphere causes water vapor supply, which can be the source of heavy rainfall events. It is one of the factors that can directly explain Japan's climate, including the rainy season.

High-resolution climate simulations are necessary to depict rainfall phenomena accurately. In our research, we analyzed simulations that do not rely on empirical assumptions of the formation and disappearance of global clouds but use the global atmospheric cloud-resolving Nonhydrostatic ICosahedral Atmospheric Model (NICAM), which enables direct physics-based calculations. Consequently, we were able to directly calculate convective rainfall phenomena such as convective clouds and rainfall accompanying tropical storms. The simulations depict a more realistic formation process of clouds and rain as compared to existing low-resolution climate simulations, enabling the prediction of future changes in Asian monsoon rainfall.



Screenshots of satellite observation data, simulations, and artificial intelligence obtained during the analysis of climate change (using programming)

Effects brought about by the Asian monsoon

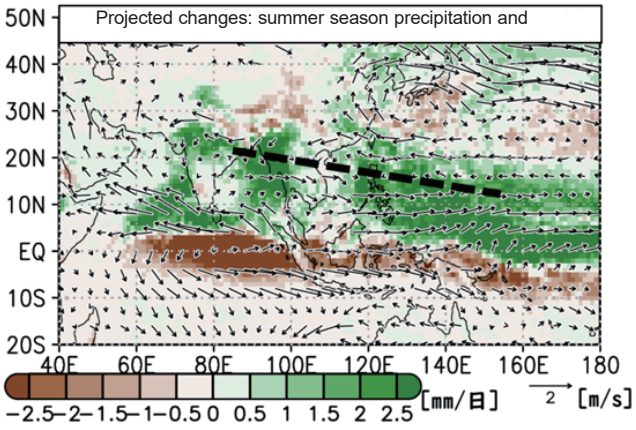
After conducting a detailed analysis of high-resolution simulation data, our projections indicate that precipitation is expected to notably increase in the belt-shaped area called the monsoon trough that stretches from northern India eastward to Indochina and the western Pacific. In addition, as we examined expected future changes in tropical cyclone activity, including that of typhoons, and found that predicted changes are consistent with variations in precipitation in the monsoon trough to a considerable extent. This indicates that future rainfall changes in the Asian monsoon region are strongly associated with tropical cyclone activity.

Furthermore, we examined how future changes in sea surface temperatures could affect precipitation in the Asian monsoon region. In order to separate the effects of a uniform rise in global sea surface temperature from those of the El Niño phenomenon and other similar sea surface temperature patterns, we conducted separate simulations for each of the above conditions. The simulations indicated that a uniform rise in global sea surface temperature has a major effect on the change in precipitation in the Asian monsoon region.
The research results imply that a growing tropical cyclone activity and a further uniform rise in global sea surface temperature are major contributing factors to variations in precipitation in the Asian monsoon region.

Future prospects

Our research revealed that rainfall phenomena accompanying tropical cyclone activity, including typhoons, are a major factor responsible for future rainfall changes in Asian monsoon region, including Japan. This also shows that tropical cyclone activity is greatly affected by the uniform rise in global sea surface temperature associated with global warming.

To better understand future changes in the climate of the Asian monsoon region, including in Japan, we expect to conduct research within this framework, which includes tropical cyclone activities. It is also believed that the relationship between the Asian monsoon and tropical cyclone activity is a key factor to be considered in recent extreme weather events in the Asian monsoon region.



Projected changes in precipitation (future climate – present climate) (green: increase; brown: decrease)

Simulation results of future precipitation changes using the NICAM cloud formation prediction model (NICAM). The dashed black line demarcates the monsoon trough where tropical cyclones such as typhoons are active. Precipitation in areas along the monsoon trough is projected to increase due to tropical cyclone activity.

To high school students

Extreme weather events caused by climate change are anticipated to worsen. For example, heavy rains and extreme heatwaves are expected to increase, and may have a significant impact on our lives and the natural environment. To address these problems, it is important to understand climate change scientifically using meteorological and climatic knowledge and prepare appropriate disaster management measures. In order to be able to scientifically understand climate change, it is necessary to acquire data analysis and programming skills, particularly so because, recently, we also started employing artificial intelligence (machine learning) techniques. People who can scientifically analyze climate projections and propose solutions that are useful to society are in great demand.

High Performance and Reliability Enhancement in Power Electronic Circuits

Assistant Professor **WADA Keiji**

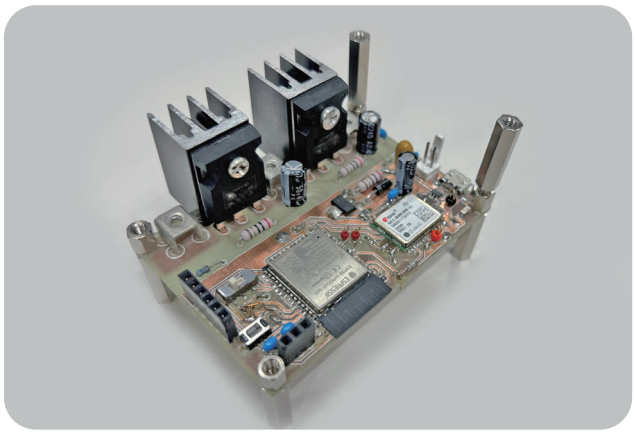
Graduate School of Systems Design, Department of Electronics and Information System Engineering

The Faculty of Systems Design, to which I belong, is a state-of-the-art department that conducts comprehensive education and research on system technology from two perspectives: function and sensitivity. My own research focuses primarily on improving the performance and reliability of power electronic circuits. Power electronics technology, which enables energy-saving in home appliances and is indispensable for the power supply of renewable energy, plays an important role in achieving a decarbonized society and contributes to various areas.

Power Electronics: A Technology Closer to Us Than We Think

Power electronics is a technology that uses power semiconductors to freely control voltage, current, and frequency. It is widely used in various fields, including home appliances such as air conditioners, refrigerators, and lighting, as well as in mobile phone chargers, electric vehicles, and railways. For example, when using household appliances with a home power outlet, a circuit incorporating power electronics is inserted between the electricity sent from the power company and the appliance, enabling more efficient power utilization.

To improve the efficiency and reliability of power electronic circuits, advancements are necessary not only in circuit design but also in the development of new power semiconductors and improvements in peripheral components. Even if a single component achieves outstanding performance, it does not necessarily improve the performance of the system as a whole.



A circuit made by students in the lab

Power Electronics Supporting the Realization of a Decarbonized Society

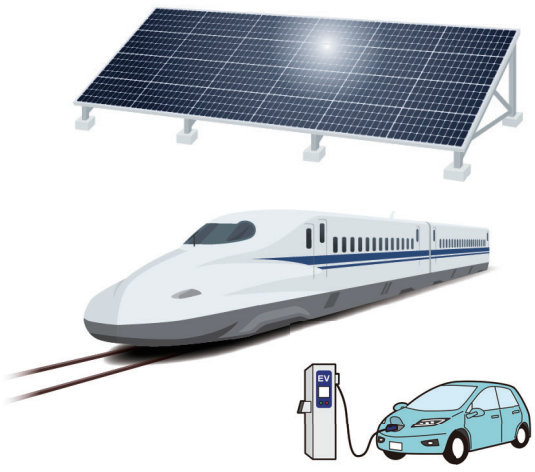
● Efficient Use of Renewable Energy

Power electronics are essential for the widespread adoption of solar power and other renewable energy sources.

When supplying electricity generated from renewable sources such as solar and wind to the power grid, output must be adjusted due to fluctuations caused by seasonal and weather conditions. Power electronics play a crucial role in this adjustment process.

In addition, transformers mounted on utility poles are based on well-established technology and are used worldwide. By incorporating power electronics into these transformers as a new technology, it will become possible to supply larger amounts of electricity to the power grid in a more stable manner.

Furthermore, the use of power electronics enables "local production and consumption of electricity," where renewable energy is generated close to areas of demand. This reduces transmission losses and helps achieve a more stable and efficient power supply.



Power electronics technology is indispensable for realizing a decarbonized society

• Efficient Use of Vehicles

Power electronics are used to efficiently operate the motors of electric vehicles, trains, and Shinkansen bullet trains. Compared to the past, power electronic circuits have become significantly more compact and lightweight, reducing the energy consumption required for transportation.

For example, in Shinkansen, the miniaturization of power electronic circuits has created space to install batteries, enabling the train to continue running to the next station even if power from the overhead lines is interrupted.

Power Electronics Supporting the Realization of a Decarbonized Society

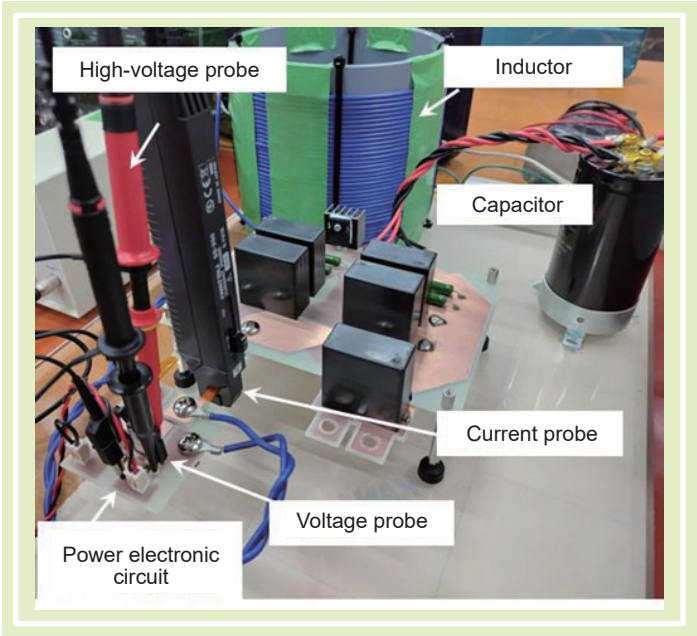
Currently, research is underway on the multifunctionalization of power electronics, where information and communication technology are integrated with the power energy field. This includes achieving high-precision synchronization of multiple power electronic circuits operating simultaneously and performing coordinated control. As this technology becomes more established, it will enable more efficient transfer of electrical energy.

Research is also being conducted on detecting failures in power semiconductors used in power electronic circuits. If the lifespan of semiconductors and other components can be predicted, proactive replacement of parts will be possible, further improving product reliability.

Graduate students at the Tokyo Metropolitan University Power Electronics Laboratory are engaged in these research and development efforts on a daily basis. Specifically, they devise new circuit and control methods, conduct theoretical calculations, and run computer simulations. In addition, to verify their research findings, the graduate students also design and build power electronic circuits themselves.

Of course, the process begins with purchasing electrical and electronic components to create new circuits. Students do more than just learn circuit design—they gain hands-on experience by assembling purchased components, soldering, and working with their hands. Throughout this process, they apply knowledge not only from electrical and electronic engineering but also from mathematics, physics, information science, and communications, allowing them to develop practical skills and expertise.

To drive innovation in the field of electrical and electronic engineering, proficiency in AI, programming, and a strong foundation in physics and mathematics for design are essential. These areas of knowledge are indispensable for supporting the future of the electronics and electrical industries. I believe that experiencing manufacturing firsthand during their student years is crucial, even if they go on to work in product design and development after graduation. I hope that students will develop a broad perspective on society and grow into individuals who can support the transition to a decarbonized society.



Power electronic circuit designed and built in the lab, with a rating of 400V and 10A

"T-MIT Birdman Club" Receives The Japan International Birdman Rally 2023 Environmental Award!

The T-MIT Birdman Club participated in the Human-Powered Propeller Aircraft Division of the Japan International Birdman Rally 2023, held in July 2023, and won the Environmental Award*. This award recognized the club's environmentally conscious approach to aircraft construction. We interviewed Adachi-san, a third-year student and a member of the club's 2024 executive committee.
*The Environmental Award was newly established in 2023, making T-MIT Birdman Club its first recipient.

Please describe the activities of the T-MIT Birdman Club

The club goes through all the processes necessary to participate in the Birdman Rally. Before constructing the aircraft, we select a pilot and hold a meeting to establish the budget. Subsequently, club members with expertise in aviation determine the type of aircraft to design and build a prototype. Generally, five teams work on different components of the aircraft: one for the wings, another for the gearbox (the mechanism that transmits pedal power), and so on. The final aircraft is assembled by integrating parts from all five teams. Once the aircraft is completed, we perform multiple safety flight tests at an airport.

Weekly meetings are held to ensure effective communication among team members and the club as a whole.

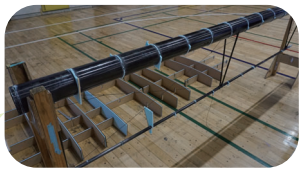
Flight test

Which efforts do you think were recognized for the Birdman Rally Environmental Award?

The aircraft was recognized for its design, which prioritized using only the essential materials and emphasized recycling and resource conservation. We repurposed materials recovered from aircraft that had landed on water during previous Birdman rallies. Aircraft construction typically generates significant waste, so we actively evaluated which materials could be recycled within the club. For example, we explored whether recyclers could process discarded main wing materials. To further minimize waste, we focused on reducing material usage which also led to lighter aircraft designs. A lighter aircraft not only reduces the pilot's pedaling burden but also extends flight distance, and results in a synergistic effect of reduced waste production, making the aircraft environmentally friendly.

Additionally, waste materials were reused to create shelves and workbenches for aircraft manufacturing. We also delivered lectures at neighboring high schools as part of our Birdman Club's activities to support efforts aligned with the SDGs, which the present-day Birdman Rally emphasizes.

Making prototype of wing part on workbench built from scrap wood



Reuse of usable parts and materials.

How did the things you studied at university help you in building the aircraft?

My primary field of study at university is design and structure of aircraft and rockets. Therefore, I was able to apply the concepts learned in the classroom to practical aircraft development. Conversely, I sometimes learn about the structure in my classes after having built the aircraft and realize that what I have studied is applied in practice in various situations. The Birdman Club's activities provide numerous opportunities for this. Additionally, I used my knowledge of material mechanics to determine the breaking points of materials and optimize the weight of the aircraft. While general education courses taught me the importance of environmental consciousness, my studies on aircraft design and structure helped me understand that lightweight aircrafts have low environmental impact.

Aircraft "VEGA" moments before flight.

Although our appearance on the Birdman Rally's TV program is brief, we dedicate an entire year to building an aircraft with passion and commitment. We deeply appreciate the ongoing support that enables us, as students, to persistently challenge our limits.

ADACHI Shuma Third-year student
Department of Aeronautics and Astronautics
Graduate School of Systems Design

Webinar Held with the University of Malaya: Sharing Sustainable Initiatives

On December 18, 2023, Tokyo Metropolitan University and the University of Malaya co-hosted a webinar to share recent research on sustainable initiatives, ideas, and activities such as the Eco-Campus. The University of Malaya, located in Malaysia, is a key partner university for Tokyo Metropolitan University, with both institutions having a long-standing international exchange agreement. Over the past decade, they have actively exchanged students and faculty members. This webinar was held as part of an exchange program under this agreement, where panelists from both universities gave lectures and presentations on sustainable initiatives and Eco-Campus activities, including collaborations with government agencies.

Program

Opening Remarks

Keynote Speeches

- Tokyo Metropolitan University: “Utilization of CO_2”
- University of Malaya: “Urban Heat Island Phenomenon in the Tropics: Challenges and Proposals”

Sustainable Initiatives (Presentations)

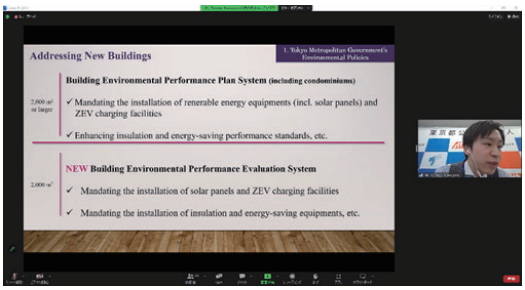
- Tokyo Metropolitan University Initiatives
- University of Malaya Initiatives

Practical Sustainability on Campus (Presentations)

- Tokyo Metropolitan University
  - Challenges of Nature Management in Human-Centered Ecosystems
  - Green Space Management on Campus: For Conservation, Education, Research, and Community Engagement
- University of Malaya
  - Sustainability Leadership
  - Eco-friendly Practices: The Role of the University Botanical Garden

Closing Remarks

In his opening remarks, YAMAMOTO Ryoichi, President of the Tokyo Metropolitan Public University Corporation, highlighted the growing need for climate change response within the field of education. He expressed the Corporation’s commitment to achieving a sustainable campus and conveyed gratitude for the opportunity to discuss and share climate change countermeasures with the University of Malaya. The board member of the University of Malaya, in turn, expressed appreciation for the international partnership with Tokyo Metropolitan University, emphasized the important role higher education plays in future environmental conservation, and stated the intention to continue working together to create a better future together.



On the day of the webinar

On the day of the event, 67 faculty, staff, and students from both universities participated. According to the results of the post-event questionnaire, more than 90% of the participants were very satisfied or satisfied with the seminar. Participants expressed that the reasons for their satisfaction included the timeliness of the topics and the opportunity to learn more about the environmental initiatives of both universities.

The webinar concluded with an emphasis on the critical importance of international collaboration, and that based on what was shared, Tokyo Metropolitan University and the University of Malaya will continue to work together to achieve carbon neutrality on campus.

東京都立産業技術大学院大学
ADVANCED INSTITUTE OF INDUSTRIAL TECHNOLOGY

Overview

●Name	Advanced Institute of Industrial Technology
●Date of Establishment	April 2006
●President	HASHIMOTO Hiroshi

Number of students, faculty, and staff (As of May 1, 2024)

*Faculty and staff numbers include temporary staff.

Number of students
230

Number of faculty
27

Number of staff
33

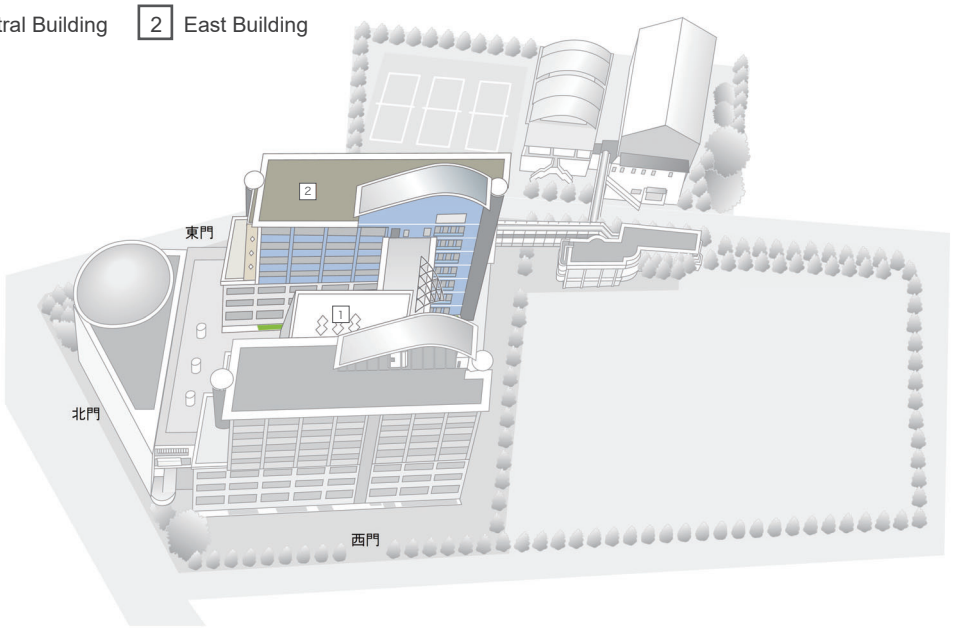
Features

The university offers three courses: the Business Systems Design Engineering Course, which trains “business innovators” who will create future value through entrepreneurship, business start-ups, and succession; the Information Systems Architecture Course, which develops “information architects,” super-players in the field of information technology; and the Innovation for Design and Engineering Course, which cultivates “manufacturing architects” who bring innovation by integrating sensitivity and functionality. These courses provide advanced practical education through collaboration between faculty members with extensive real-world experience and those with high research achievements, aiming to develop professional, highly specialized experts who will bring innovation to various fields.

Campus Map

Shinagawa Seaside Campus

1 Central Building 2 East Building



Land and buildings 1-10-40, Higashioi, Shinagawa-ku, Tokyo 140-0011 Land area: 37,134.15 m2 Total floor area: 4,625.88 m2 (Shared use of the Tokyo Metropolitan College of Industrial Technology Shinagawa Campus)

Message from the President

President, Advanced Institute of Industrial Technology

HASHIMOTO Hiroshi

I would like to talk about environmental issues.

Whenever people and things are active, energy (including food) is inevitably consumed. Activities drive the economy and enrich people' s lives. Moreover, in the context of global recovery from wars and natural disasters, restoring daily life will consume vast amounts of cement and steel.

Agriculture, which accounts for 25% of all CO_2 emissions, and the cement and steel industries, which together account for 14% of emissions (*), are expected to be in conflict with environmental issues.

Next, promoting a DX society requires securing rare metals and rare earths. However, mining and refining these materials generate large quantities of pollutants and radioactive waste. If strict management is not implemented, there is a significant risk of severe environmental pollution.

Solving environmental problems requires considering the trade-offs intertwined with various factors, such as the richness of life, recovery, a sustainable society, a DX society, and the diverse values of each individual. It is essential to develop human resources capable of managing these challenges holistically in line with the flow of the times. This complexity connects to the concept of VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) often discussed today. Furthermore, individuals capable of responding to VUCA are said to be able to address the global goal of a sustainable society, SDGs. In other words, people who can address environmental issues can also respond to the SDGs.

Outstanding individuals who can tackle complex issues in real-world society are said to excel in competencies. The introduction of competency as an indicator stemmed from research in the 1970s that showed little correlation between staff capabilities in U.S. government agencies and IQ or educational background. Since then, the concept of competency has expanded, and many different indicators have been proposed.

At our university, we define competency as the ability to perform tasks and have developed our own indicators and measurement methods for competencies suitable for each field of industrial technology, as well as learning methods, which we have put into practice. The results of our efforts are recognized not only in Japan but also by various institutions and organizations overseas. To contribute to solving complex environmental issues and building a hopeful future society, we will continue to nurture human resources who have honed their competencies.

*Reed Landberg and Jeremy Hodges: What decarbonization means for cows, steel and cement, Bloomberg QuickTake, Oct.,08, 2019

Future Mobility and Infrastructure Design as Systems

Professor TAKASHIMA Shinji
Graduate School of Industrial Technology

I conduct research on the creation of values and systems for the future social environment, industry, and daily life through “broad design.” Here, I will briefly describe the contents of a project-based learning (PBL) theme entitled “Future Mobility and Infrastructure Design as Systems.” The underlying concept is that of bringing “happiness” to people by focusing on the “qualitative” value of “Move.” Although predicting the future is difficult, the aim of the research project is to realize a “desirable” future using backcasting.

Historical examination of “purpose of ‘Move’”

What does “Move” mean to people? Approximately 700,000 years ago, it was started as a means of “food supply” and “coexistence.” Since then, “Move” has actively played a part in establishing, for example, “civilization and culture,” “religion,” “politics,” and “economy.” Approximately 50 years ago, the role of “Move” also expanded into “fun.” Recently, the “meaningfulness of ‘Move’” has changed further as the separation of real and remote work, which has become widely accepted due to the COVID-19 pandemic.

Reconfirmation of the “value of ‘Move’” working backward from the “10-year future vision”

In designing concept and concrete design, to enhance accuracy of the vision, setting a target and having a future vision free of current values and goals are important.

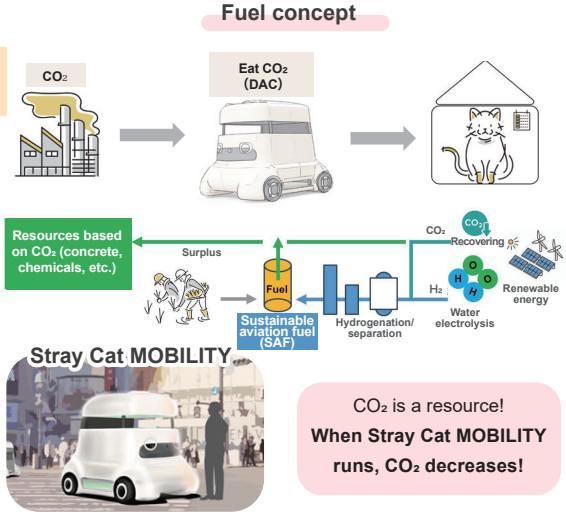
We conducted a survey targeted at 18-year-olds, the result of which showed that many young people are feeling that life is not inconvenient but not abundant; they are not inconvenienced without “Move” but need something new. Furthermore, they want to stop global warming but do not know what they can do.

In modern society, while attention is given to electrification and renewable energy, energy problems must be viewed from the perspective of humans and nature on a global scale; otherwise, national conflicts may occur. Furthermore, our major objective is to become carbon negative by shifting from excess “oxidation reactions” to enhanced “reduction reactions,” which will not be widely spread throughout the world unless a balance is established between environmental conservation and industrial/economic activities. In other words, we need to think from the perspective of creating values that people want as well as solving problems.

The value of “Move” is important not only “quantitatively” (reaching destinations quickly and economically), but also “qualitatively” (experiencing unforgettable fun and excitement)

Realization of the new “value of ‘Move’”: Setting requirements and describing design performance

Environmental performance will become an inevitable requirement in the overall life cycle of products and services. To further promote environmental performance, incorporating a new “value of ‘Move’” in future mobility will be necessary while taking into consideration changes in people’s feelings and the mindset of “Move’ and its qualitative value. Given this background, we established the concept of meeting various things we never knew before as “Considering future energy ‘Meets’ Mobility.”
Thus, we set “coincidence,” “inconvenient benefits,” “healing,” and “environmental performance” as necessary requirements and laid out functions and specifications to accomplish the requirements. Further, we designed “Stray Cat MOBILITY.”



Toward a society that makes people happy with Stray Cat MOBILITY

The time will come when “environmental performance” is regarded as a “given.” Solutions to environmental problems must not be considered independently. For them to be widespread, they must be installed in the world as “new values” that the future generation would want to accept. In other words, thinking about the meanings of “happiness” and “joy” for the future generation, nature, and the earth is important.

In a time when we do not know what will happen tomorrow, predicting the future is almost impossible. However, envisioning the future with intention and preparing for the realization of the vision is possible. “Broad design” not only solves the immediate problems but also considers the kind of world we want people to live in and the kind of happiness and joy we want people living there to have, ultimately realizing it.

Tokyo Metropolitan College of Industrial Technology
東京都立産業技術高等専門学校

1st Year

Shinagawa Campus	Arakawa Campus

Regular course First-year student : class common throughout program

2nd to 5th Year

Program Selection System

Mechanical Systems Engineering Program	Information and Telecommunication Engineering Program
Production Systems Engineering Program *Applicable to students enrolled before FY2020	Robotics Program
AI and Smart Engineering Program *Applicable to students enrolled from FY2021 onward	Aerospace Engineering Program
Electrical and Electronic Engineering Program	Medical and Welfare Engineering Program
Electronics and Information Engineering Program *Applicable to students enrolled before FY2020	
Information Systems Engineering Program *Applicable to students enrolled from FY2021 onward	

Overview

- ●Name: Tokyo Metropolitan College of Industrial Technology
- ●Date of Establishment: April 2006
- ●President: YOSHIZAWA Masasumi

Number of students, faculty, and staff (As of May 1, 2024)

*Faculty and staff numbers include temporary staff.

Number of students 1,645

Number of faculty 119

Number of staff 70

Features

Our school aims to nurture highly skilled engineers through eight specialized educational courses that provide practical training. We also offer hands-on programs in fields such as information security and aviation technology. To develop engineers with an international perspective, we provide overseas experience programs and international exchange initiatives to support students in becoming globally active. In addition, we offer cutting-edge manufacturing education that incorporates AI and IoT technologies, as well as “Medical Mechanic Cooperation Education, Research Project” in partnership with the medical field, focusing on the social implementation of technology.

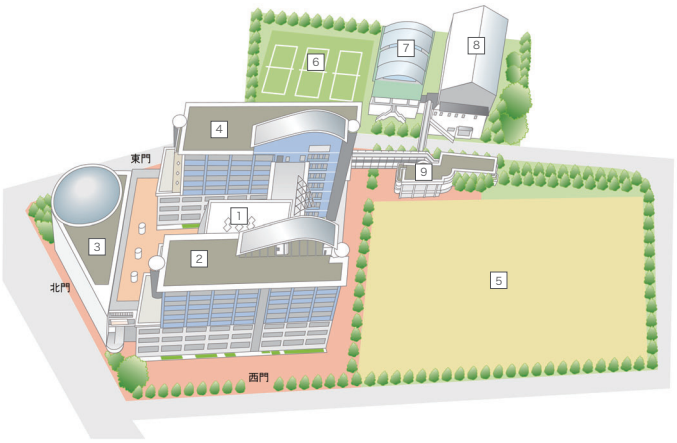
Graduates of the five-year regular course can earn the title of associate degree holder, and further advanced specialized knowledge and skills can be acquired in a two-year advanced course. Upon completion of the advanced program, graduates can obtain a Bachelor’s degree in Engineering after review by the National Institution for Academic Degrees and Quality Enhancement of Higher Education. This contributes significantly to the cultivation of engineers who will play a major role in promoting industrial development and technological innovation in Tokyo.

*Due to the course reorganization in FY2021, there will temporarily be 10 courses until FY2024.

Campus Map

Tokyo Metropolitan College of Industrial Technology Shinagawa Campus

1 Central Building　2 West Building　3 North Building
4 East Building　5 Playground　6 Tennis Court
7 Pool Building　8 Gymnasium　9 Gymnasium

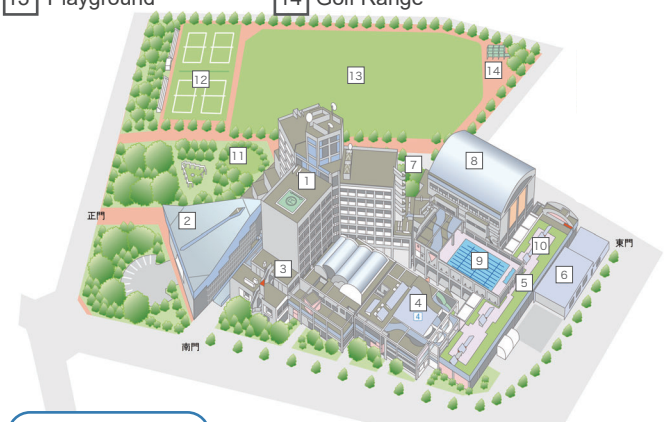


Land and buildings 1-10-40, Higashioi, Shinagawa-ku, Tokyo 140-0011

Land area: 37,134.15 m2 Total floor area: 34,139.54 m²

Tokyo Metropolitan College of Industrial Technology Arakawa Campus

1 Main Building　2 Science and Technology Exhibition Hall
3 Joint Research Center　4 Laboratory Building
5 Laboratory Building　6 Aviation Training Building
7 Multi-Purpose Plaza　8 Gymnasium　9 Pool
10 Roof Garden　11 Student Plaza　12 Tennis Court
13 Playground　14 Golf Range



Land and buildings 8-17-1 Minamisenju, Arakawa-ku, Tokyo 116-8523

Land area: 48,370.10m2 Total floor area: 31,496.24m²

Message from the Principal

Principal, Tokyo Metropolitan College of Industrial Technology

YOSHIZAWA Masasumi

The Sustainable Development Goals (SDGs), adopted at the UN summit in 2015 with a deadline of 2030, are already two-thirds of the way through.

These 17 goals are critical objectives for all countries in the world to strive towards. In addition to national efforts, proactive initiatives at the local government level are expected.

In large cities like Tokyo, there are numerous challenges due to the massive consumption of resources and energy, encroachment on nature in exchange for convenience, and the emergence of new infectious diseases. These challenges, magnified by the scale of urbanization, require collaborative efforts from industry, academia, government, and citizens.

At TMCIT, we have been contributing to solving Tokyo’ s issues by training practical engineers for many years. From an early stage after junior high school graduation, students receive five years (seven years for those progressing to the advanced course) of hands-on, specialized education, preparing them to excel in various sectors of the industry. Furthermore, we aim to cultivate engineers who possess both the ability to apply and imagine creative solutions to the rapid advancements, diversification, and globalization of science and technology. This aligns with SDG Goal 9, “Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation,” and Goal 4, “Ensure inclusive and equitable quality education.” Moreover, female engineers who acquire technical skills are more likely to achieve “Gender equality” (Goal 5). Students involved in developing energy-efficient cars and human-powered aircraft are mindful of the importance of “Affordable and clean energy” (Goal 7). Thus, the educational activities carried out at this institution are highly compatible with the SDGs, and I am confident they will continue to be beneficial in achieving them.

Starting from FY2025, the Electrical and Electronics Engineering Program at the Shinagawa Campus will undergo a curriculum revision and will begin as the Electrical, Electronic and Energy Engineering Program. “Electrical, Electronic and Energy Engineering” is a technical field that supports societal infrastructure such as energy, information, communication, and transportation. In addition, it is expected to play a central role in solving global environmental and energy issues. The Electrical and Electronic Energy Engineering course at TMCIT aims to develop “engineers who can adapt to social trends and technological advancements and contribute to the creation of a sustainable society” and “engineers who understand green energy generation and conversion technologies and digital IoT technologies and can implement both hardware and software.” These engineers will support and contribute to the rapidly changing society.

This year, in this environmental report, we introduce research related to power supply and demand adjustment systems for large-scale solar power generation. We also highlight the climate change-related demonstration experiments in the Future Workshop at the Shinagawa Campus, and local initiatives related to drinking water at the Arakawa Campus. While these are small activities, we are pleased to see that they have gradually changed the awareness of students.

Electricity Supply and Demand Adjustment System for Massive Growth in Solar Power Generation: Fostering Awareness in the Classroom

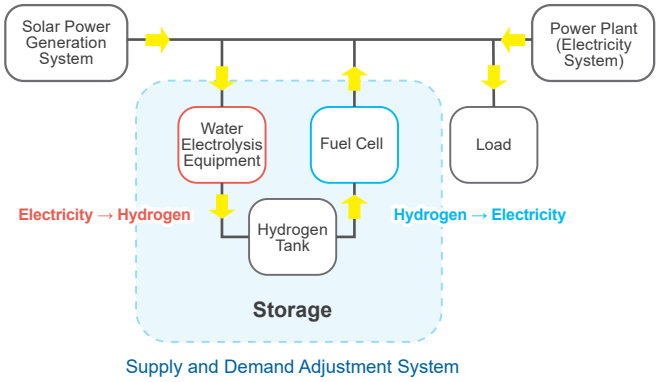
Associate Professor **KAWASAKI Norihiro**
Electrical and Electronics Engineering Program Monozukuri Department

In my laboratory at the Tokyo Metropolitan College of Industrial Technology, research has been conducted on electricity supply and demand adjustment systems associated with power system operations. Special attention has been given to solving the problems that accompany the massive growth of renewables. While pursuing research activities, I encourage students in my laboratory to think and act in order to solve problems. I also make efforts to develop and produce human resources that can contribute to the realization of a carbon-neutral society

Electricity supply and demand adjustment system utilizing hydrogen energy

In the future, there will be a society in which renewable energy will grow in massive volumes. If solar power plants generate electricity on a large scale, a stable supply of electricity will be affected by frequency fluctuations. One solution to this problem is to use hydrogen storage in an electricity supply and demand adjustment system. Using this method, the excess electricity generated by solar power plants can be converted and stored in hydrogen and supplied as electricity when required. While hydrogen has a high storage capacity and easy transport, its solar-to-hydrogen efficiency is low, producing losses. Therefore, examining ways to improve the efficiency is also necessary.

In my research, numerical simulations were primarily conducted to examine electricity supply and demand, transmission and distribution networks, and the scale of hydrogen production and storage facilities required for smooth adjustment of electricity supply and demand by each power company. By presenting operation methods that minimize the cost of hydrogen storage capacity and prevent the generation of excess electricity, assuming a certain growth in solar power generation in the future, I believe the potential of this adjustment system can be quantitatively demonstrated. From an educational point of view, I built tabletop-sized laboratory devices (small-scale simulation system equipment) to test whether the system actually works. I devise different experimental methods daily, enabling students to design, assemble, and operate the circuits while learning how to solve the problems that arise.



Supply and Demand Adjustment System Diagram

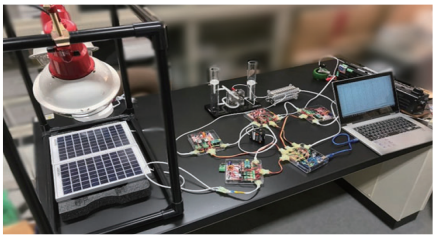
In simulations, variations in solar radiation, the input energy for solar power generation, are considered at the municipal level.

Cultivating and producing human resources capable of realizing carbon neutrality

I feel that what students learn at college and from this research helps raise their awareness of carbon neutrality. When I teach, I emphasize not only the technological aspects but also the challenges that arise and the entire process of addressing and solving them. Furthermore, to enhance my communication skills, I have students deliver presentations and provide explanations that can be understood by those outside the field. These experiences will undoubtedly help students to communicate effectively when they begin working.

Students always surprise me with their flexible thinking and ability to achieve research results through their experiences with various communities. I hope they will take advantage of the skills acquired during their school years in their future endeavors.

Achieving carbon neutrality requires societal awareness changes. In a society in which electricity is taken for granted, it is difficult for consumers to change their awareness and force themselves to do so. To naturally realize a carbon-neutral society, I believe it is important to create a structure that technologically supports society. I hope to contribute to the realization of carbon neutrality by conducting research on technological aspects, and cultivating and producing human resources.



Experiment on electricity supply and demand adjustment using small-scale simulation system equipment

Water electrolyzers, fuel cells, solar cells, and loads were arranged on a table for control and measurements.

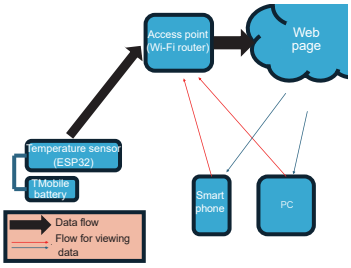
Future Workshop: "Temperature Changes in Indoor Spaces Due to Heat Shielding"

Shinagawa Campus

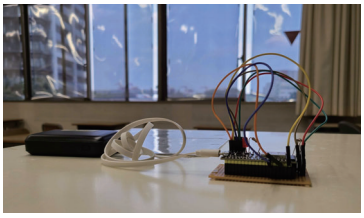
The Tokyo Metropolitan College of Industrial Technology has a system called the "Future Workshop," which gathers various ideas and challenges related to manufacturing from students and provides support for selected activities.

In FY2024, as part of this Future Workshop, three fourth-year regular course students at the Shinagawa Campus conducted experiments on effective ways to alter indoor temperatures using materials that are easily accessible in everyday life. This initiative comes in response to ongoing global warming and skyrocketing electricity costs.

1. ***Date and Time*** August 19, 2024 (Monday) to August 27, 2024 (Tuesday), from 8:40 a.m. to 4:00 p.m.
2. ***Location*** Three classrooms in the east side, 3rd Floor, of the Shinagawa Campus
3. ***Motivation for the Experiment*** The experiment was inspired by individuals who felt hot in classrooms, as well as those who found the air from air conditioning too cold, prompting thoughts on more efficient indoor temperature regulation.
4. ***Implementation Procedure***
   (1) Install four modules and mobile batteries at separate locations within the three classrooms (a total of 12 units), each programmed to measure temperature.
   (2) On the first day, no coverings are applied to the windows. The classrooms are sealed and the air conditioning is turned off to measure the temperature.
   (3) From the second to the fourth day, install shading film, insulation sheets, and screens on each classroom's windows, then measure the temperature without air conditioning.
   (4) Starting from the fifth day, place one circulator in each classroom and turn on the air conditioning for temperature measurement.
   (5) Measurements are managed via a web-based application. Data collected every 10 minutes is sent to the app in real time, making it accessible for monitoring on PCs or smartphones at any time.
   (6) Analyze the data collected from (2) to (4) to summarize the characteristics and differences in temperature rise for each material used.

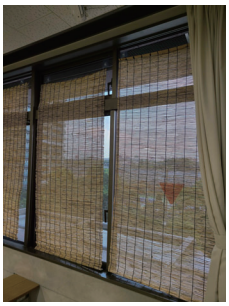


System for collecting measurement data

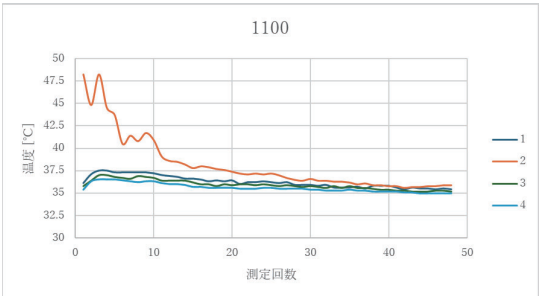


Measurement module (temperature sensor)





From left to right: Shading film, insulation sheets, and bamboo blinds on windows



Example of measurement results

5. ***Discussion and Conclusion***
   Seats near the windows receive direct sunlight, so by applying insulation sheets before sunrise, it is possible to suppress the temperature rise. Shading film and bamboo blinds allow some sunlight through, so they may not be effective in reducing temperature on sunny (strong sunlight) days.

   On the other hand, when the fan circulator was activated, the temperature continued to drop at all measurement points until around noon for the first three days. After noon, the temperature began to rise. This suggests that circulating cool air early in the day helps lower the temperature, and once the cool air dissipates and the entire room stabilizes at a certain temperature, the temperature starts to rise. Based on this, we hypothesize that using air conditioning from around noon may allow for a relatively comfortable environment throughout the day.

   Considering the properties of each material used (shading film: significantly reduces solar heat, preventing heat from entering the room; insulation sheet: delays heat transfer due to the air layer in the sheet, but blocks sunlight completely, making the room dark; bamboo blinds: block light while allowing air to pass through, making it harder for heat to enter. When water is applied to them, they lower the temperature by about 2 degrees), we conclude that in a detached house, installing bamboo blinds wetted with water outside would be ideal, while in apartment buildings, shading film should be used, and if neighboring houses are close, insulation sheets could also be installed for privacy.

The Future Workshop covers a wide range of ideas, such as robot creation and system development, reflecting the creativity of technical college students. In this experiment, students recognized global warming as a local issue, using materials and familiar modules to explore ways to reduce indoor temperature rise. The results of this experiment were presented at the achievement report meeting held on October 26 during College Festival in Shinagawa campus 2024, where many people were able to view the findings.

Behavioral Changes Through the Installation of Water Dispensers

Arakawa Campus

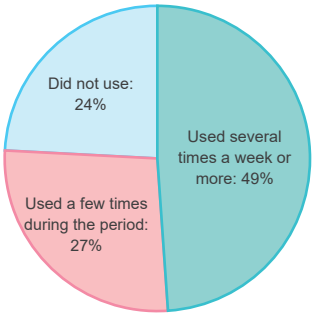
From mid-June for about a month and a half, a water dispenser was experimentally installed in a corner of the Arakawa Campus cafeteria, with the student and administrative offices as the main users, encouraging its use by students and staff.

During this period, when the temperature consistently exceeded 30 degrees Celsius, we saw overflowing PET bottles in the trash bins next to the vending machines on campus. However, the water dispenser, which allowed direct refills into large water bottles and flasks, was widely welcomed and had a noticeable effect on reducing waste.

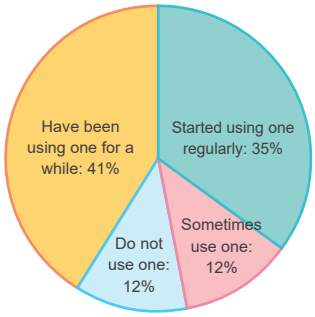
To clearly assess this impact, a survey was conducted primarily with water dispenser users among students and staff, and the results are shown in the following graph (excerpt).

Water dispenser installed at the Arakawa Campus

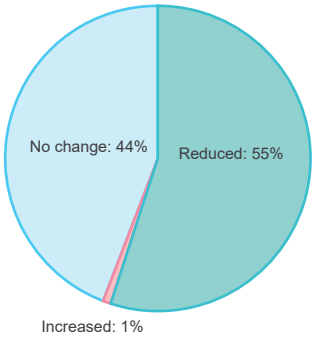
Usage of the water dispenser



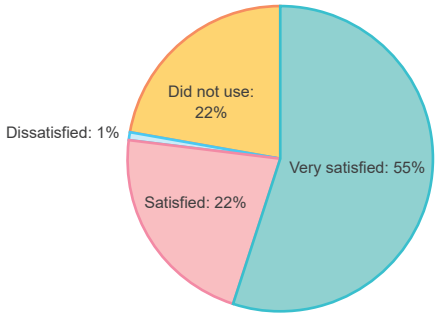
Usage of personal bottles



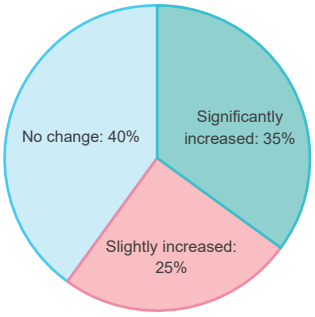
Purchasing bottled beverages



Satisfaction with the water dispenser



Awareness of environmental issues



We believe that we are currently achieving “SDG Goal 6: Ensure access to water and sanitation for all.” However, through initiatives like this, we aim to gradually raise awareness that this is not something to be taken for granted on a global scale.

Given the strong positive reception of the water dispenser installation, we are considering its continued use in the future.

Third-Party Opinions

Policy Planning Section, General Affairs Division
Bureau Environment, Tokyo Metropolitan Gorvernment

As we face unprecedented torrential rains and life-threatening heat waves, the climate crisis has become a dire threat to our very existence. Amid warnings of a “climate hell” caused by global warming, it is more critical than ever to advance efforts toward decarbonization.

The role of cities, where the climate crisis manifests most acutely, has never been more significant. Tokyo, for instance, will launch Japan’ s first-ever mandate requiring solar panel installations in new residential buildings starting next fiscal year. By spearheading the shift to renewable energy from Tokyo, the city aims to achieve its goals of halving carbon emissions by 2030 and reaching zero emissions by 2050.

Your corporation has set ambitious goals through the “Carbon Neutrality Promotion Plan,” aiming for a 50% reduction in carbon emissions by 2030 (compared to FY2013 levels) and achieving carbon neutrality by the 2030s. In addition, the “TMU Sustainable Research Promotion Organization” has been instrumental in advancing research to address policy challenges under the theme of “sustainability,” which is a vital initiative.

The measures outlined in this report—including visualizing performance indicators for tackling environmental impacts such as greenhouse gas emissions, electricity and water consumption, and waste generation associated with educational and research activities—are commendable. Further notable efforts include research into energy management in anticipation of an era of widespread renewable energy adoption and biodiversity conservation initiatives. The “Nature Positive Declaration,” the first of its kind among national and public universities, highlights your organization’ s pioneering and comprehensive environmental efforts.

Expectations for universities and other institutions of higher education are increasing as they contribute to society through decarbonization-related research and produce talented individuals across diverse fields. As the only public university corporation established by the Tokyo Metropolitan Government, we anticipate that your corporation’ s advanced research and activities will gain broader recognition and contribute significantly to building a sustainable society.

Environmental Reporting Guidelines Comparison Table

We included a comparison table with the “Environmental Reporting Guidelines 2018 Edition” issued by the Ministry of the Environment.

Item	Relevant page(s)
Chapter 1 Basic Information on Environmental Reporting	
1. Basic Requirements for Environmental Reporting	1
2. Trends in Key Performance Indicators	9-13
Chapter 2 Contents of Environmental Report	
1. Commitment from Senior Management	2,15,22,32,35
2. Governance	4,6
3. Stakeholder Engagement	14,39
4. Risk Management	13
5. Business Model	3,4,20,21,31,34
6. Value Chain Management	8-12
7. Long-Term Vision	5-7
8. Strategy	5-7,14
9. How to Identify Critical Environmental Issues	5-7
10. Important Environmental Issues for the Organization	5-7,14-19,23-30,33,36-38,41

Introduction to Research Related to Carbon Neutrality and Nature Positivity

In addition to the research introduced in the previous section, Tokyo Metropolitan University, the Advanced Institute of Industrial Technology, and the Tokyo Metropolitan College of Industrial Technology are conducting research related to Carbon Neutrality and Nature Positive initiatives. For detailed research summaries, please visit this website.

	CN (Carbon Neutral)	NP (Nature Positive)	Total
Tokyo Metropolitan University	37	5	42
Advanced Institute of Industrial	3	2	5
Tokyo Metropolitan College of	15	3	18
Total	55	10	65

Introduction to Classes Related to Carbon Neutrality and Nature Positivity

Tokyo Metropolitan University offers various courses related to Carbon Neutrality and Nature Positive. You can find the list of related courses offered in FY2024 on this website.

		CN	NP	Total
General University-Wide Courses	English, & Uncompleted Language Courses (Basic Courses)	4	5	9
	Basic Seminar & Information Literacy (Basic Courses)	2	0	2
	Fundamental Courses	1	0	1
	General Education Courses	9	7	16
	Health and Physical Education & Career (Basic Courses)	1	0	1
Specialized Education Courses	Faculty of Humanities and Social Sciences	0	1	1
	Faculty of Economics and Business Administration	1	0	1
	Faculty of Science	2	6	8
	Faculty of Urban Environmental Sciences	18	9	27
	International Minor	1	1	2
Total		39	29	68

	CN	NP	Total
Graduate School of Humanities	4	0	4
Graduate School of Business Administration	9	0	9
Graduate School of Science	4	3	7
Graduate School of Urban Environmental Sciences	8	9	17
Graduate School of Systems Design	2	0	2
Total	27	12	39

Total	107

*The number includes overlaps of CN and NP.

*Faculties, departments, etc., with zero related courses are excluded from the number.

Contact Information

Tokyo Metropolitan Public University Corporation

Management &Planning Office, Planning & Planning & Finance Division

Email：ecogr@jmj.tmu.ac.jp

TOKYO METROPOLITAN UNIVERSITY
東京都立大学

東京都立産業技術大学院大学
ADVANCED INSTITUTE OF INDUSTRIAL TECHNOLOGY

Tokyo Metropolitan College of Industrial Technology
東京都立産業技術高等専門学校

Toward a Sustainable Society

Tokyo Metropolitan
Public University Corporation