Tokyo Institute of Technology
Environmental Report Digest Version

Tokyo Tech

2022

Tokyo Tech Continues to Change as We Strive for Greater Heights

Kazuya Masu
President, Tokyo Institute of Technology

Even three years after the outbreak of COVID-19 no end is in sight to the pandemic that has threatened people’s lives and health, disrupted the global economy and otherwise brought about many social changes. Meanwhile, the global impact of climate change is becoming greater every year. Tokyo Tech will do its best to address and solve these various problems with an eye to creating a better future.

In particular, as part of our efforts to tackle the issue of climate change and help achieve the government’s goal of carbon neutrality (reducing overall greenhouse gas emissions to zero) by 2050, Tokyo Tech established the Laboratory for Zero-Carbon Energy in 2021 to consolidate our energy research resources and conduct innovative R&D into non-fossil fuels and systems for using them. In collaboration with industry, government, academia, the community and international research institutions, we aim to conduct “green transformation” R&D through open innovation to identify and solve the issues associated with building sustainable energy systems.

In March 2018, the Minister of Education, Culture, Sports, Science and Technology designated Tokyo Tech as a Designated National University Corporation. In 2019, we established the InfoSyEnergy Research and Education Consortium to strengthen integrated energy science — a priority area in pioneering the frontiers of science and technology. The Consortium actively employs “big data science” in our various research projects and conducts comprehensive joint energy research alongside companies. We also foster the next generation of leaders in the energy field through distinctive educational programs with a viewpoint that encompasses the humanities and social sciences, as well as through collaborations with companies. In this way, the Consortium conducts education and research in a holistic manner, promoting energy education and research from a broad perspective.

Through these efforts, Tokyo Tech will tackle environmental issues while tracking the changes in research and education that occurred in response to social issues. At the same time, we strive to fulfill our mission as a research and education institute by giving the fruit of our academic endeavors to society. We will do this in accordance with our basic principle on environmental policy, in which we see the problems as major challenges on a global scale that pose an existential threat to all of humanity. To ensure that future generations have a viable global environment, Tokyo Tech will contribute to the creation of a sustainable society as it fulfills its mission as a research and education institute.

We hope you will read this report and continue to support Tokyo Tech activities.

Overview of the Tokyo Institute of Technology

Tokyo Institute of Technology Environmental Policy

Enacted January 13, 2006

Basic Principle

As we strive to become the world's best science and engineering university, Tokyo Institute of Technology recognizes that environmental problems are not just issues for certain regions. They are major challenges on a global scale that pose an existential threat to all of humanity. To ensure that future generations have a viable global environment, Tokyo Tech will contribute to the creation of a sustainable society as it fulfills its mission as a research and education institute.

Basic Policies

In accordance with the basic principle "To share the global environment with future generations," Tokyo Tech will deal with the various problems facing the environment, based on the following policies, to create a twenty-first century civilization in which the earth and humanity coexist harmoniously.

Research Activities

We will further promote scientific and technological research that contributes to the creation of a sustainable society.

Talent Development

To foster the creation of a sustainable society, we will develop talented individuals with high environmental awareness, a rich knowledge base, and the potential to become leaders in

Social Contribution

We will contribute to Japan and the world through our research activities and talent development.

Reduce Our Environmental Footprint

We will establish environmental goals, develop plans based on those goals, and execute those plans to minimize our impact on the environment.

Environmental Management System

We will create an advanced environmental management system suitable for a world-leading science and engineering university, implement it effectively, and strive to continually improve it.

Promote Environmental Awareness

We will conduct environmental education and awareness-building activities that target every student and university employee, including executives, to increase their understanding of Tokyo Tech's environmental policies, etc. and the environmental awareness of everyone associated

Setting Up the Laboratory for Zero-Carbon Energy

On June 1, 2021, Tokyo Tech reorganized the Laboratory for Advanced Nuclear Energy of the Institute of Innovative Research and set up the Laboratory for Zero-Carbon Energy (also known as the Zero Carbon Lab or ZC Lab).

When we entered the twenty-first century, we believed this would be an era of convenience and abundance of goods and information. That sense was short-lived. Now at the mercy of environmental changes such as rapid climate change and the spread of infectious diseases, humankind is beginning to recognize the magnitude of nature and the powerlessness of human beings. The ZC Lab was created to reflect on twentieth-century society's overdependence on fossil resources and to shift to a carbon-neutral (CN) society that is friendlier to the global environment.

This laboratory's goal is to help create a CN society by building a carbon and material circulation system based on zero-carbon energy (ZCE). We are now conducting research and development of the technologies necessary to achieve this goal. Figure 1, which illustrates a CN society, shows Japan's vision for realizing carbon neutrality by 2050: shifting the energy supply side from dependence on fossil fuels to ZCE, namely renewable and nuclear energy.

Figure 2, meanwhile, shows the ideal energy society that the ZC Lab is determined to create. First, ZCE is introduced as primary energy. Since the output of renewable energy (one type of ZCE) fluctuates greatly based on weather conditions, it is essential to stabilize the output. Since the demand side also fluctuates, energy storage is also essential, so electricity storage (batteries) and heat accumulation functions are vital.

The demand side also requires the supply of carbon resources in many fields. It is therefore also crucial to capture emitted carbon dioxide, use ZCE to convert it into carbon resources for recycling and reuse, and supply the converted resources in the form of energy carriers (*1). It is also essential to recover, separate and regenerate energy material and substances.

In addition, although nuclear energy causes anxiety among many in society, we must view nuclear energy as a valuable source of zero-carbon energy, develop safe and economical nuclear energy systems, and promote research on radiation application technologies. The ZC Lab conducts comprehensive research on elemental technologies such as the production, efficient utilization, storage, material conversion, social use and recycling of ZCE in all its forms — as well as the construction of energy networks that optimize each of these forms — with the aim of contributing the technology needed to create a sustainable energy society.

Finally, we are developing the Green Transformation Initiative (Tokyo Tech GXI) (*2) to accelerate research. Green transformation (GX) refers to changing the structure of industry and society in response to the need to achieve CN. The Tokyo Tech GXI aims to solve new issues related to GX through open innovation in collaboration with industry, academia, government, society and citizens. Achieving GX cannot be done with individual technologies. It requires the collaboration of many research efforts. We are developing the ZC Lab's activities in cooperation with people and organizations in Japan and around the world to maintain a beautiful global environment.

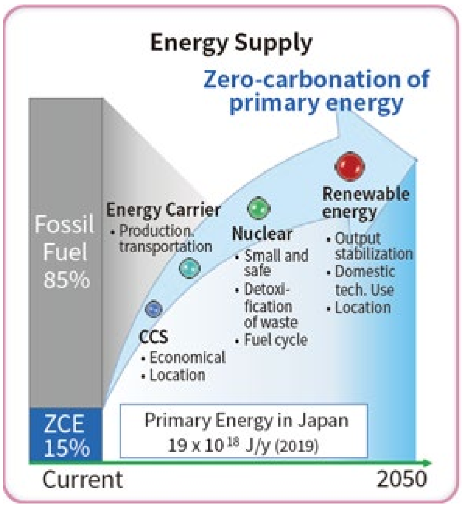


Fig. 1 Prospects for zero carbonization of primary energy

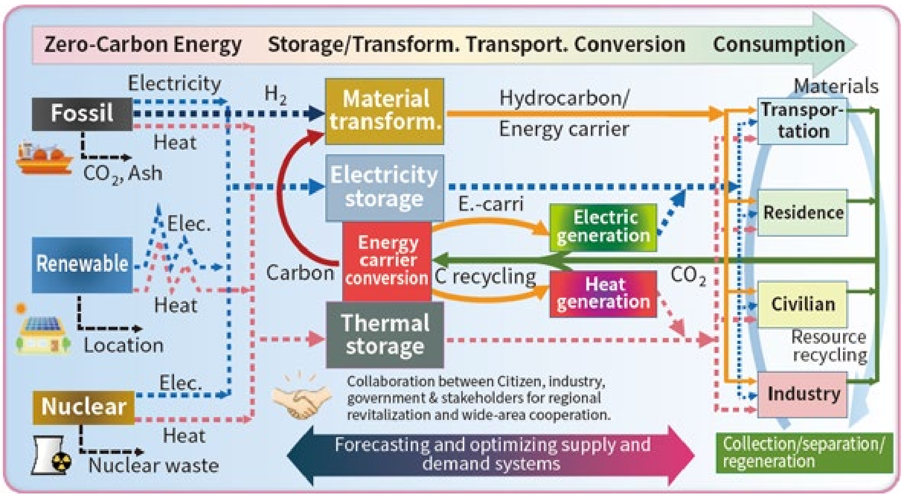


Fig. 2 Energy society aimed at by the ZC

*1 Energy Carriers

Energy carriers are substances generated using zero-carbon energy that are transported to the use side, where they are used to generate energy again. Hydrogen, ammonia and synthetic fuels such as methane and methanol are typical examples.

*2 Green Transformation Initiative（Tokyo Tech GXI）

http://www.zc.iir.titech.ac.jp/en/GXI/index.php

Laboratory for Zero-Carbon Energy：http://www.zc.iir.titech.ac.jp/en/index.php

Aiming to Build a Discipline of Regional Symbiotic Renewable Energy Planning

Associate Professor Shigeo Nishikizawa
Department of Transdisciplinary Science and Engineering
School of Environment and Society

Solving the Green Dilemma Is Essential to Decarbonization

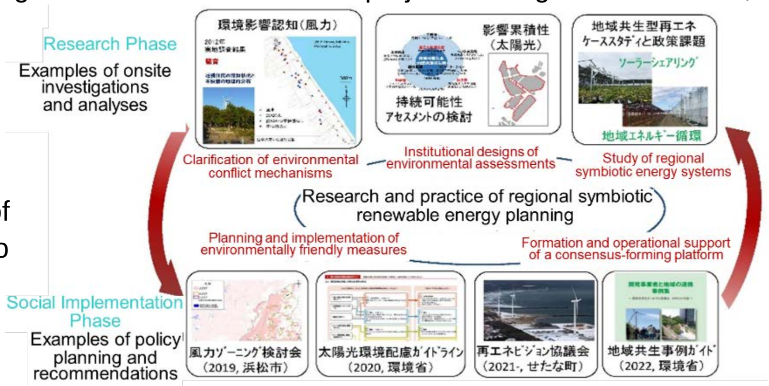
A decarbonized society is a shared global goal, and various initiatives aimed at achieving it are currently underway in Japan. Achieving this goal will require a structural transformation of society. In the energy sector, the optimal implementation of renewable energy has been set as a national policy of the highest priority. Wind and solar power are expected to become our main power sources.

Although wind, solar, and other clean energy sources are generally known for not emitting greenhouse gases, the reality is that there are endless problems and complaints associated with the implementation of clean energy projects in the regions where power generation facilities are constructed. While electricity is essential to our lives, it is impossible to completely negate the impacts and risks associating with energy production. In Japan, people have recently started to refer to renewable energy facilities using the acronym NIMBY (for "Not In My Backyard"). The term refers to the phenomenon of people being in favor of renewable energy in theory but against it in practice (namely, against facilities being constructed near their homes). The question we need to answer is how to simultaneously solve both the *global* warming problem and the *local* environmental problems that introducing renewable energy causes. We refer to this conundrum as the "green dilemma."

Our Research Mission: Building a Discipline of "Regional Symbiotic Renewable Energy Planning"

Our laboratory's research will lead to policy recommendations from the standpoint of environmental planning to resolve such energy dilemmas. We are taking a two-pronged approach to find (1) measures that mitigate environmental impacts and (2) measures that create local benefits. More specifically, we are developing a methodology for simultaneously achieving two goals: formulating measures that reduce the negative impacts associated with renewable energy projects, and ensuring that those projects have a positive impact on the community. We call this academic discipline "regional symbiotic renewable energy planning."

The local problems related to renewable energy vary from case to case, but include noise, spoiled scenery, deforestation, bird collisions, and sediment disasters. Often local residents and environmental conservation groups oppose these projects, even in some cases by local governments. We are working to clarify the mechanisms of such environmental conflicts. Taking the characteristics of each project and region into account, we use surveys, analyses of location characteristics and other means to determine what factors lead to such conflicts and their resolution. We are striving to develop a methodology to achieve the aforementioned two goals. For the first goal, we consider the use of environmental assessments as a mechanism to clarify environmental concerns to help prevent problems before they arise. For the second goal, we explore options for creating local benefits by promoting energy circulation and other measures to build consensus in the community.



Conceptual Diagram of Nishikizawa Lab

Contributing to Society through Policy Recommendations and Planning Support

We will feed the knowledge we acquire through our research back to the real world in the form of policy recommendations. We collaborate with the Ministry of the Environment, local governments and the private sector to implement renewable energy plans. Our feedback is incorporated into policies and initiatives such as zoning, which refers to location guidance planning aimed at the smooth introduction of renewable energy in a region. That feedback is also used to create environmental consideration guidelines, regional renewable energy visions, and collective best practices. While these activities are meant to help achieve goals such as a sustainable society and decarbonization, they are also valuable opportunities to discover new research needs.

Nishikizawa Lab: http://www.nishikiz.depe.titech.ac.jp

Microbial synthesis of eco-friendly plastic materials

Professor Toshiaki Fukui

Department of Life Science and Technology
School of Life Science and Technology

Plastics are lightweight, durable, and fabricable materials, leading to be essential materials for our modern society. However, many plastic products produced by petrochemical industry are single-use thus immediately discarded after the use. Since most of these petroleum-based plastics are hard to be degraded in natural environments, plastic wastes are causing serious environmental pollution, especially in oceans and forests. It has been recently shown that a large amount of mismanaged plastic wastes enters from land into ocean. These plastic wastes and microplastics, formed by breakdown of plastic products, are now accumulating in natural environments and concerned to cause adverse effects on ecosystems as well as our health. At the G20 summit held in Osaka in June 2019, the member countries shared Osaka Blue Ocean Vision, which is designed to prevent additional pollution caused by marine plastic waste by 2050. Managing and recycling of plastic wastes are important actions addressing this plastic pollution problem, while it is difficult to completely eliminate the influx of plastic wastes to natural environments. One of solutions to this problem is development and application of plastics that can be degraded and disappeared in the natural environments.

In nature, diverse kinds of microorganisms accumulate polyhydroxyalkanoates (PHAs), polyesters composed of hydroxyalkanoate units, within the cells as a storage compound of carbon and energy. Some kinds of PHAs exhibit plastic properties as well as biodegradability, meaning that they can be degraded by microorganisms in natural environments (Figure 1). In addition, PHAs are not petroleum-based but bio-based, because they can be produced from biomass feedstocks such as the sugars and vegetable oils.

Based on these properties, PHAs have been attracted as useful polymeric materials with a low environmental impact. It has been particularly demonstrated that PHAs are actually biodegradable in marine environments.

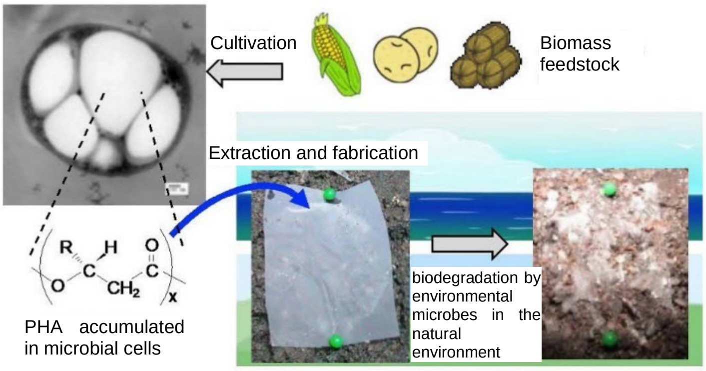


Figure 1: Polyhydroxyalkanoates (PHAs) synthesized by microorganisms

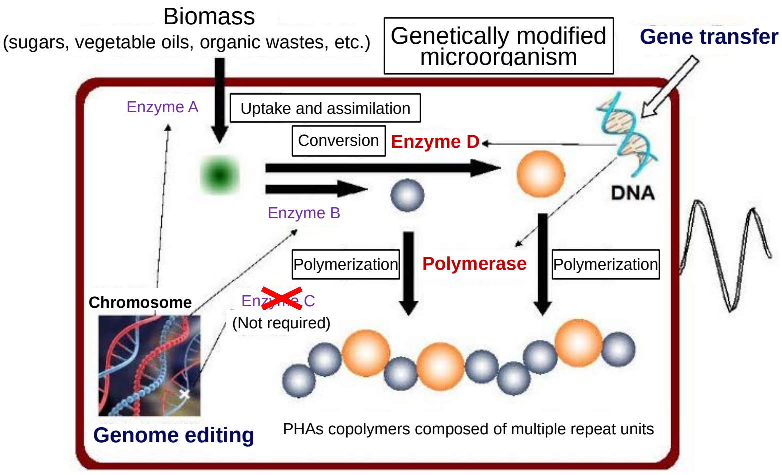


Figure 2: Breeding copolymer polyester-producing microorganisms through genetic modification

A homopolyester of (*R*)-3-hydroxybutyrate, poly((*R*)-3-hydroxybutyrate) [P(3HB)] is the most abundant kind of PHA in nature. Unfortunately, P(3HB) is hard and brittle, resulting in limited range of the applications. In the cells of PHA- producing bacteria, hydroxyacyl-CoA monomers generated from carbon source via related metabolic pathways are polymerized into high-molecular-weight polyester chains by the function of a polymerizing enzyme, PHA synthase. These enzymes acting on metabolism and polymerization are encoded in the bacterial genes, thus they can be genetically modified to biosynthesize PHAs with altered physical properties through the copolymerization of monomers with different structures (Figure 2).

Our lab is conducting research on engineering of microorganisms that can efficiently produce practical PHAs from inexpensive biomass feedstocks. Namely, several genetic modifications are introduced into PHA-producing bacteria to enhance their uptake and assimilation ability to variety of carbon sources, as well as to establish artificial pathway for formation of monomer compounds and the following polymerization.

Although “microorganisms” and “plastics” are looked like a strange combination, we intend to demonstrate a practical example that the great abilities of microorganisms can help us to solve the environmental problems.

Fukui Lab: http://www.fukui.bio.titech.ac.jp/

Q&A：Scientific and Technological Research Contributing to the Environment

Q&A　Associate Professor Shigeo Nishikizawa

Q1. What inspired you to begin researching this field?

About twenty years ago after I got my PhD, I visited the Swedish island of Gotland, a World Heritage Site, as part of a research project. We toured an offshore windmill farm and a small hydroelectric power plant on a river, and listened to a local government official's presentation on the community's vision for introducing renewable energy in the region. Ten years later, I saw a wind power generation facility in Izu at a study camp my seminar students organized. I learned about the troubles between local residents and renewable energy facilities. As an environmental policy researcher, these experiences inspired me to help achieve decarbonization.

Q2. What do you mean by "creating local benefits," which you say will help solve the "green dilemma"?

One way of doing this is to return part of the profits from selling electricity to the community via a fund. This method's advantage is its great flexibility in deciding who receives the funds and how they will be used, such as promoting the region's agriculture, forestry and fisheries industries or community development. Solar sharing, in which vegetables and other crops are grown under solar panels, is popular now. It spurs local production and local consumption of electricity, such as using the electricity solar panels generate on farmland to hydroponically cultivate tomatoes.

Q3. What does an environmental assessment entail?

Environmental assessments are mechanisms used to predict and evaluate the impact of roads, railroads, dams, waste disposal sites, power plants, urban development and other projects to ensure their impact on the environment and society are considered. The procedure is unique, with the studies conducted while communicating with the various stakeholders having an interest in the project, such as residents and environmental NGOs.

Q4. What are your aspirations regarding environmental issues, SDG initiatives and so on?

Environmental assessments must evolve into sustainability assessments that look at both environmental aspects and socioeconomic aspects. One major issue in this evolution is how to incorporate the Sustainable Development Goals into sustainability assessments. We would like to tackle such themes.

～Message to Students～

The world is changing as it moves towards decarbonization. Every organization and person needs the ability to adapt to this change. When you see decarbonization as your own issue, your vision of the future and worldview will change.

Q&A　Professor Toshiaki Fukui

Q1. What inspired you to begin researching this field?

My graduate research was on application of enzymes for conversion of organic compounds, and hoped to conduct research in genetic engineering field after getting the doctoral degree. Fortunately, I joined a lab focusing on microbial polyesters and started to work regarding genetic analysis of novel PHA-producing bacterium. The bacterial plastics is a quite interesting and exciting topic, still motivating me to the research activity.

Q2. What kinds of products are suitable for plastics made from microorganisms?

The bacterial polyesters are expected to be suitable for plastic products for outdoor uses, such as those for agriculture and fishing, and single-use products such as food packaging, cutleries and straws, having a risk to enter in natural environments.

Q3. What challenges does the practical application of plastics made with microorganisms present?

Improvement of the physical and mechanical properties and expansion of the range of material types for a variety of applications, as well as establishment of the low-cost production.

Q4. What are your aspirations regarding environmental issues, SDG initiatives and so on?

I like to make further efforts to apply the great potential of microbes and biotechnology as one of solutions against the current environmental problems.

～Message to Students～

Research work is often tough and hard, however, you will feel exceptionally grad when you obtain good results by your own idea and ingenuity. I hope you find research that interests you based on the knowledge learnt by the courses, and then, enjoy science !

Environmental Education and Human Resource Development: Enhancing Our Environment-related curriculum

[Global Environment and Energy Systems] Graduate Course: Graduate Major in Nuclear Engineering

Associate Professor Takuya Harada
Department of Chemical Science and Engineering, School of Materials and Chemical Technology

Faced with the serious climate crisis of global warming, countries around the world have begun to act to halt its progress. Global warming is caused by greater concentrations of carbon dioxide and other greenhouse gases released into the atmosphere as a result of human activities since the Industrial Revolution of the eighteenth century. To put it another way, the consumption of energy is associated with these activities. Evaluations conducted by the Intergovernmental Panel on Climate Change, among other things, have made this increasingly clear.

In the graduate course "Global Environment and Energy Systems" (NCL.O513) that our Nuclear Engineering graduate major offers, students engage in quantitative and practical studies of the deeply interrelated problems of the global environment and energy in terms of energy supply, conversion and utilization processes, as well as energy policy (Figure 1).

Humans consume energy in various forms, including electricity, heat and motive (transportation). This energy comes from fossil fuels, which are ancient solar energy converted and stored in energy carriers, particularly carbon; nuclear energy, produced by nuclear transmutation and nuclear reactions; and renewable energy, such as solar, wind and hydroelectric power. To establish a new sustainable energy system, we must reconstruct the current system based on in-depth quantitative analyses of the characteristics and current usage quantity of each source and the different impacts they have to determine how to best use various energy sources. We also need to develop new materials and technologies to run this new system.

The goal of this course is to ensure that the students who will be the next generation of leaders will develop the solid foundation of academic knowledge and initiative needed to enable them to fulfill their crucial roles as engineers, scientists and policymakers.

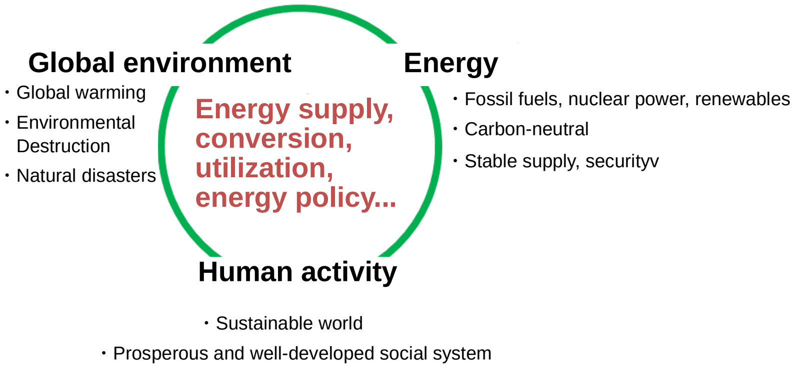


Figure 1: Course content and the correlation between the global environment and energy

【Tokyo Tech Academy of Energy and Informatics program】

Professor Manabu Ihara
Director, Tokyo Tech Academy of Energy and Informatics
Professor, Department of Chemical Science and Engineering, School of Materials and Chemical Technology
(Infosy**Energy**/Research and Educaion Consortium Head)

The goal of the Tokyo Tech Academy of Energy and Informatics is to develop Multi-Scope・Energy WISE Professionals who will help realize a sustainable, human-centric energy society free of usage constraints such as costs and CO_2 emissions. This will involve using tools for the intelligent use of energy, such as AI-based big data analysis. After mastering multidisciplinary energy science, these individuals will transform and design this new energy society using big data science and their social design skills. We will achieve this through the Tokyo Tech Academy of Energy and Informatics program. Students in the Energy/Information courses, who are selected from across the schools, will complete a unique and seamless master's-doctoral educational program and have opportunities to participate in industry-academia collaborative research. They will also receive substantial financial support.

The training of Multi-scope・Energy WISE Professionals is an integral part of the activities of the InfoSy**Energy** Research and Education Consortium, which is comprised of energy- and information science-related companies, public institutions, top overseas universities, and Tokyo Tech faculty members. The consortium aims to improve the quality of industry-university collaborative research and human resource development together by linking research and education (see Figure 1).

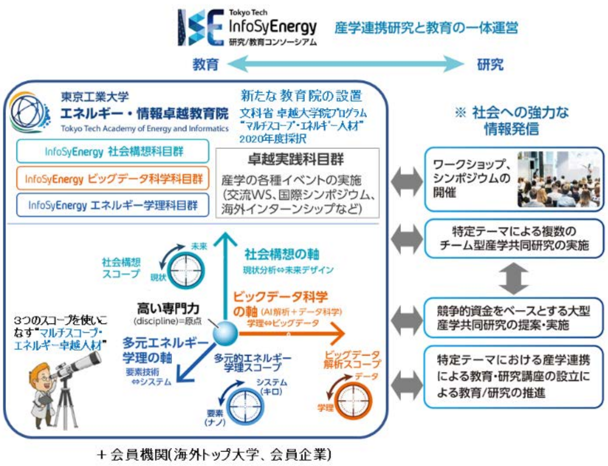


Figure 1: Overview of the Tokyo Tech Academy of Energy and Informatics Program and InfoSy**Energy** Support and Collaboration System

Learning about Volcanic Disaster Prevention with Local Stakeholders

Associate Professor Akihiko Terada
Volcanic Fluid Research Center, School of Science

When you think of volcanic disaster preventions, what comes to mind? Evacuating to shelters to avoid volcanic ejecta (Figure 1) is an invaluable step to saving lives. However, installing countless concrete structures on volcanoes, which create beautiful scenery and nurture diverse flora and fauna, is impractical from both a cost and environmental conservation standpoints.

Should we make volcanoes off-limits, then? This would mean severing a relationship between nature and humanity. So how should we live with volcanoes? Local residents are the stakeholders of a disaster prevention initiatives when faced with a volcanic eruption. They need a deep understanding of volcanoes so that they can consider their options and make better decisions on their own.

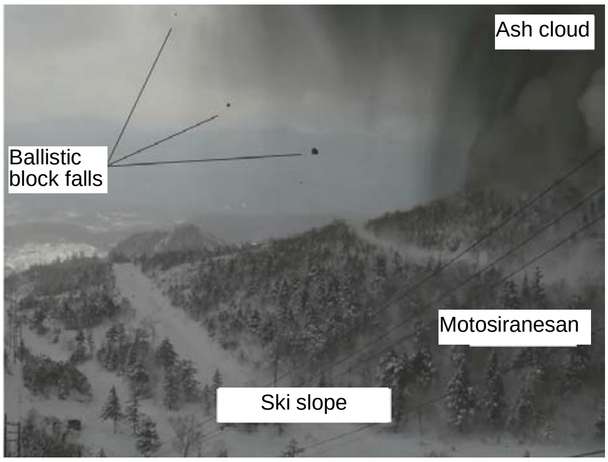


Figure 1: Falling ejecta during the 2018 eruption of Mount Kusatsu-Shirane (courtesy of Kusatsu Onsen Tourism Association)

Tokyo Tech Initiatives

Tokyo Tech has a volcano observatory in Kusatsu Town, Gunma Prefecture, where Mount Kusatsu-Shirane is situated. The observatory is staffed by full-time faculty members, and has monitored the volcano 24 hours a day for more 30 years. This accumulated experience and knowledge is provided to local governments and other entities through the Volcano Disaster Prevention Council, which was established under the Act on Special Measures for Volcanoes, to assist them in making decisions. In addition, we proactively provide opportunities for children to learn about volcanoes. As children grow into adults and become the stakeholders in the community, it is essential to give them opportunities to experience the beauty, wonder and power of volcanoes.

Volcano Study Event

In 2019, we held an event entitled “Volcanoes, Hot Springs and Our Lives” at the Kusatsu Onsen ski resort in the town of Kusatsu, with 116 children and parents attending (Figure 2). The event was incorporated into a program organized by the Kusatsu Onsen Tourism Association.

Considering that most participants were elementary school third-graders and younger, students of my laboratory suggested that we use a quiz format that would allow parents and children to learn while thinking together. Such parent-child experience allows to provide an opportunity for the current stakeholders, busy people in their 30s and 40s, to learn about volcanoes. Once the COVID-19 pandemic subsides, we hope to continue this activity.

Figure 2: “Volcanoes, Hot Springs and Our Lives” event, held June 30, 2019

Volcanic Fluid Research Center website http://www.ksvo.titech.ac.jp/jpn/

Tokyo Tech VG Environmental Conservation Activities

Kei Matsumura
Third-Year Undergraduate Student
Department of Civil and Environmental Engineering, School of Environment and Society

Campus Cleanup Activities

As the effects of the COVID-19 pandemic continued in FY2021, the Tokyo Tech VG student volunteer group found it difficult to volunteer in person as we had in the past.

While it was expected that fewer students coming to campus would mean less trash on campus, this expected decrease had not been verified. As part of our environmental preservation activities, we therefore conducted a campus cleanup to investigate where people were littering and what sort of litter was most common.


VG Members Participating in Campus Cleanup

In March 2022, we walked the East and West areas of Ookayama Campus, from Taki Plaza to Extracurricular Activities Bldg. 3, collecting empty cans, plastic bags and other trash along the way. Our findings from this activity are as follows:

- There was a lot of litter around the Extracurricular Activities Buildings. In particular, there were many large pieces of litter, such as shards of broken glass and plastic umbrellas. Many personal items likely belonging to members of sports clubs were left at the back of the athletic field.
- Lots of plastic bottles and empty cans were dumped in hard-to-see and hard-to-reach places, such as hedgerows.
- I got the impression that there was somewhat less littering compared to what I had heard about when there were trash cans on campus.


Cleaning up the Campus

Considerations and Proposals

Goal 12 of the SDGs, “Responsible Production and Consumption,” addresses the need to ensure sustainable consumption and production patterns. To achieve Goal 12, it is essential for individuals to cooperate in their own small way, whether by carrying reusable bottles and bags around with them or not buying things likely to become trash. Such behavior would help to beautify the campus by keeping trash away from it.

It seems that we need to have a greater sense of ownership of our trash. Many of us may think that once we throw trash into a trash can we have nothing to do with it anymore, and the trash is adequately handled by someone else. This may lead to people believing that dealing with litter scattered around trash cans is not their responsibility. This is likely what leads to people forcing trash into an overflowing trash can or just tossing it nearby. We as individuals create trash. Each of us needs to be aware that the creators of trash are responsible for disposing of it themselves or having cleanin g staff do so. If everyone has this awareness, it will lead to a society that produces less trash. There are still many cases of littering by student clubs and groups. To prevent littering, it is essential to encourage students to become aware of the trash problem. As users of the athletic field, Extracurricular Activities Building and other campus facilities ourselves, we want to consider and propose measures to maintain a beautiful environment.


Collected garbage

Tokyo Tech VG (Student Volunteer Group)
https://www.facebook.com/TitechVG

Mirai Draft 2021
We Took the Runner-up Grand Prize, the BIGLOBE Award!

At Mirai Draft 2021, an event organized by the NPO World Vision Japan and sponsored by BIGLOBE, Inc., Tokyo Tech VG's idea “Let's draw the future: Notebooks exchanged to learn about one another,” won the BIGLOBE Award, the runner-up grand prize.

https://www.worldvision.jp/children/miraidraft/

We Won the Meguro City Eco-Challenge Award

We received the Eco-Challenge Award from Meguro City for making a significant contribution to environmental awareness-raising among local residents through the Environment Month Lecture Meeting we hold at Tokyo Tech every year in conjunction with Environment Month.

[Meguro City Eco Challenge Award]
https://www.city.meguro.tokyo.jp/kurashi/shizen/mondai/ecochallenge.html

Energy Conservation and CO2 Reduction Initiatives

Tokyo Tech conducts a great deal of experimental research. For this reason, the combined energy consumption of our Ookayama, Suzukakedai and Tamachi campuses is about the same as that of 20,000 typical homes. This results in high CO2 emissions for an enterprise that does not make any products. With that in mind, Tokyo Tech has set numerical goals related to energy efficiency and is pursuing initiatives to achieve them.

Activities of the Energy Conservation Section

To promote energy conservation at Tokyo Tech, we established our Energy Conservation Promotion Office in October 2010. This office was renamed the Energy Conservation Section and became part of the Office of Campus Management in April 2017 to further conserve energy. This new organization is in charge of matters including proposing, planning and carrying out policies related to the promotion of energy conservation as well as information collection.

The primary energy consumption-related laws and ordinances Tokyo Tech is currently subject to are the national Act on the Rational Use of Energy, Tokyo Metropolitan Government ordinances, and Yokohama City ordinances. In accordance with these laws and ordinances, we need to reduce energy consumption (electricity and natural gas) as a medium- to long-term initiative. To further promote energy conservation, we devised the Tokyo Institute of Technology Energy Conservation Action Plan in FY2018. Tokyo Tech formulated this plan in line with our aspiration to become a truly world-leading science and technology university, recognizing that environmental issues are of the utmost importance. To help create a sustainable society and fulfill our mission as a research and educational institution, we set a target of reducing our total energy consumption by 4 percent or more compared to FY2017 during the four-year period of the plan (from FY2018 to FY2021) through the implementation of comprehensive energy conservation measures based on a managerial perspective.

Since 95 percent of the energy we use comes from electricity, the Energy Conservation Section primarily pursues management activities related to lowering the use of electricity.

Environmental Considerations in Campus Development

Initiatives to Minimize Environmental Impact by Installing a Solar Power Generator and Other Systems

In January 2022, we installed a 10-kW solar power generation system during the phase five renovation of the main building at the Ookayama Campus.
Also in FY2021, electricity from renewable energy sources (solar power generation facilities, etc.) at the three campuses totaled around 1.9 million kWh/year, contributing to peak shaving and cutting our environmental impact.

Photovoltaic power generation at the Ookayama Campus main building (10 kW)

Initiatives to Minimize the Environmental Impact of Chemical Substances

An Overview of Chemical Substance Management at Tokyo Tech

Tokyo Tech is a science and technology university, and around 500 of its 700 laboratories keep chemical substances on hand. The chemical substances these labs use are extremely diverse, both by type and usage, with most only being employed in small quantities.

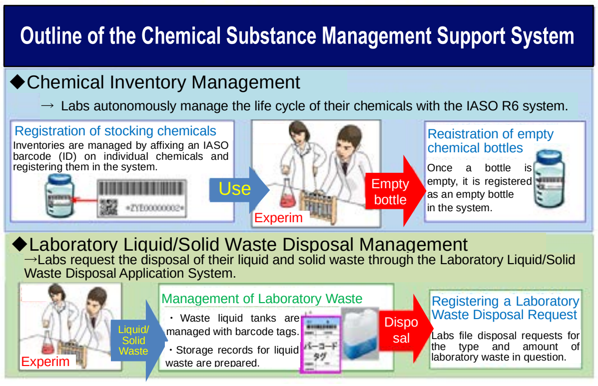
Since our labs are conducting cutting-edge research, the types and quantities of chemicals they use are changing constantly and radically. Furthermore, labs are fluid organizations with frequent turnover of students and faculty. We therefore combine multiple applications to monitor the flow of individual chemical substances on both a lab-by-lab and university-wide basis, and then use these trends to formulate measures to lower our environmental impact. This allows laboratories to autonomously manage the chemicals they use. We also hold an annual seminar on chemical substance management for faculty, staff and students to enhance their understanding of how Tokyo Tech is working to reduce our environmental impact. In addition, to ensure that no chemical substances find their way off-campus, we monitor the discharge of chemicals by conducting environmental analyses of our sewage and other possible discharge routes.

Flow and Management of Chemicals at Tokyo Tech

The typical flow of chemicals is purchase, storage and use, followed up by collection as waste liquid and waste reagents.

We track the purchase and storage/use of chemical substances with a Chemical Substance Management Support System (IASO R6). This system allows labs to properly and efficiently manage their chemical inventories. When collecting chemical substances as waste liquid and waste reagents, the amount of waste liquid collected, the amount of chemical substances contained in the liquid waste and other information is recorded using the Laboratory Liquid/Solid Waste Disposal Application System (see upper right figure).

These systems are used to monitor the usage and emission of chemical substances throughout the university in real time, as well as to drive our management activities aimed at lowering our environmental impact. For example, in the case of organic solvents — which are used in particularly large quantities — we compile quarterly totals and compare them to the level of emissions from each lab. Based on the difference, we can identify labs with the potential to release large amounts of these solvents into the environment and caution them to minimize their environmental impact (see lower right-hand side figure). This process, which we began using in 2014, is designed to control the atmospheric release of organic solvents. These systems are also used for the Pollutant Release and Transfer Register (PRTR) reporting and other administrative reporting processes.



Materials from the Chemicals Training

Labs with a Significant Discrepancy Between Usage and Emissions
It is possible that your environmental discharge is excessive, and that you are not practicing proper disposal, etc. Please note the following:
1) Take measures to minimize emissions into the atmosphere. ・Minimize atmospheric emissions as much as possible by keeping chemical bottle lids closed in the fume hood.
2) Illegal discharges into sewage, etc. ・Collect even secondary washing water as waste liquid.
3) Disposal is delayed when too much liquid waste has accumulated and been stored over a long period (years) ・Dispose of waste liquid frequently.
4) Inadequate registration of chemicals in the Chemical Substance Management Support System and the Laboratory Liquid/Solid Waste Disposal Application System ・Always register chemicals accurately and regularly. For example, do not register a large number of empty bottles at once. ・Be sure to correctly input the composition of the waste liquid actually being disposed of.

Reminder to Reduce Environmental Impact

Managing Usage Volumes with the Chemical Inventory Management System (IASO R6 system)

In 2001, Tokyo Tech introduced its own chemical substance management support system, TITech ChemRS, and had each lab autonomously managing the chemical substances it used. Since September 2014, however, we have been managing chemicals using the commercial and widely available IASO R6 management system. Labs use this system to register all of their chemicals by issuing an ID for each chemical bottle and manage the inventory in their possession (by chemical type, quantity, storage location, amount used, etc.). The system’s chemical information database (chemical master) contains data on 720,000 chemicals provided by both manufacturers and users. Among those, Tokyo Tech inventories have 60,000 bottles registered. The number of bottles used in a year totals around 30,000 to 40,000. This system makes it possible to monitor usage trends of the substances subject for PRTR reporting, the amount used, and so on.

Overall picture of research and educational activities and environmental

Tokyo Tech's activities consume a great deal of energy and a wide range of materials. Most of the energy we consume is in the form of electricity and gas. The primary materials we use are chemical substances, paper, and water. While we need to use these to conduct our cutting-edge education/talent development activities and research activities, we're also engaged in minimizing the environmental footprint of our operations.

INPUT		FY2019	FY2020	FY2021
Energy	Purchased Electricity (1,000 kWh)	↓ 66,004	↓ 59,839	↑ 67,060
	City Gas (1,000 m3)	↓ 613	↓ 430	↓ 388
	Fuel Oil (kl)	— 0.97	↑ 1.05	↓ 0.82
	Gasoline (kl)	↓ 0.2	↓ 0.1	↑ 0.2
Materials	Chemical Substances (t)	↓ 2,335 types 75.3	↓ 2,288 types 60.3	↑ 2,834 types 86.7
	PRTR-related Substances (t)	↓ 32.3	↓ 25.5	↑ 40.1
	Paper (t)	↓ 53.6	↓ 28.3	↑ 29.3
	Water (1,000 m3)	↓ 215.5	↓ 171.0	↑ 187.2

Reflecting a revival of research and educational activities, this figure even exceeded the one for FY2019

OUTPUT		FY2019	FY2020	FY2021
Atmospheric Emissions	Greenhouse Gas Emissions (t-CO2)	↓ 31,449	↓ 24,353	↑ 32,780
	Purchased Electricity (t-CO2)	↓ 29,927	↓ 23,273	↑ 31,781
	Fossil Fuels (t-CO2)	↓ 1,374	↓ 963	↓ 870
	Water and Sewage (t-CO2)	↓ 148	↓ 117	↑ 129
Waste	General Waste (t)	↓ 159.5	↓ 119.2	↑ 131.4
	Industrial Waste (t)	↓ 547.8	↓ 442.6	↑ 601.2
Water Discharged	Total Sewage Discharged (1,000m3)	↓ 213.5	↓ 168.7	↑ 186.0
	Pollutant Emissions			
	BOD (t)	↑ 14.5	↓ 10.9	↑ 12.6
	Nitrogen (t)	↑ 9.8	↓ 5.5	↑ 6.8
	Phosphorus (t)	— 0.8	↓ 0.4	↑ 0.6

RECYCLE	FY2019	FY2020	FU2021
Paper (t)	↓ 307	↓ 258	↑ 315
Other Recycled Materials (t)	↑ 404	↓ 266	↑ 331
Graywater Reuse (1,000 m3)	↓ 52	↓ 51	↑ 64

3R Movement

Reduce
Cut down the amount of trash we make

Reuse
Don't throw them away, use them again

Recycle
Transform an old item to a new use instead of throwing it away

Editorial Note

This is the second year that I've chaired the Environmental Report Preparation Working Group, and I would first like to express my sincere appreciation to everyone involved in preparing this year's Tokyo Tech Environmental Report. The working group sponsors a special Environment Month Lecture Meeting each year, where we have learned how the science clearly shows that human activity is accelerating global warming, and that carbon neutral efforts are vital.

I am a life scientist, so whenever I travel, I am always interested in the living things that inhabit the places I visit. I also love the natural environment of our planet. The cover photo of this year's report shows a green turtle coming ashore at Punaluu Black Sand Beach on the Big Island of Hawaii, which I visited before the COVID-19 pandemic.

While the sea turtle is the focal point of the cover photo, it is the black sand of this beach that I want to talk about. Kona International Airport sits on a mass of black lava; the Big Island *is* a mass of black lava. It is thought that this mass of black lava broke up and became sand, creating the black sand beaches in Hawaii.

Do you remember the news reports about the black pumice stones that the eruption of a submarine volcano in the Ogasawara Islands generated in October 2021, which later swept onto the shores of Okinawa and other coastal areas of the Japanese archipelago? These stones caused problems that included hindering the operation of ships. From a tourism standpoint, there were concerns about what would happen to the landscape if these black stones covered white sand beaches. Personally speaking, it would not have bothered me if they ended up looking like Hawaii's black beaches. When I visited Okinawa recently, though, no pumice stones were floating on the sea, and only a few remained on the beach (photo).

Because the entire beach is not black like Hawaii's black sand beaches, it is not beautiful at the moment. However, as the black pumice readily crumbles when you pick it up, it is likely that it will gradually blend into the existing whitish sand. I think that will become part of the individuality of Okinawa's beaches.

I had actually planned to collect microplastics from the ocean to show in photos in this year's editorial note, but this was not feasible.

While there have been reports of sea turtles and other sea creatures accidentally ingesting plastic bags, the plastic in the ocean is also breaking down into pieces as small as the micrometer level. It is reported that organisms (including humans) are ingesting those disintegrated plastics, which are so small that they cannot be seen without a microscope. As for the impact of these microplastics on organisms and on the planet, I will leave that as something for future working groups to tackle.

September 2022

Environmental Report 2022 Preparation Working Group Chair

Yo-ichi Tagawa

Tokyo Institute of Technology Environmental Report 2022

Relevant SDG icons are shown on each page of the report.

Basic Information Required for the Environmental Report

◇Number of Constituents（as of May 2021）

Faculty and Staff : 3，664

Students : 11，058

◇Scope of the Report

Ookayama Campus

Suzukakedai Campus

Tamachi Campus

◇Reporting Period : April 1, 2021 to March 31, 2022

Use the QR codes below to see the full version and digest of the Tokyo Institute of Technology Environmental Report 2022 (both in Japanese).

Environmental Report 2022

Digest Version

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